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Voodoo, vaccines and bed nets [a]

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Abstract

We provide the first quantitative analysis to scrutinize the ample ethnographic evidence that magico-religious beliefs affect the demand for conventional healthcare in Sub-Saharan Africa. We rely on the unique case of Benin, where Voodoo-adherence is freely reported, and varies greatly within villages and even within households, yet can be traced to historic events that are arguably exogenous to present-day healthcare behavior. These features allow us to account for confounding village- and household-factors, and address self-selection into Voodoo. We find that Voodoo adherence of the mother is associated with lower uptake of preventive healthcare measures and worse child health outcomes, a relationship that weakens but remains when controlling for village dummies and a large set of observables. We employ three different strategies to test for the potential influence of unobservables. The results suggest that the estimated Voodoo-effects are partly causal. A tentative exploration of the causal mechanisms suggests a mediating role of traditional healers.

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1. Introduction

Sub-Saharan Africa (SSA) is the region with the highest under-five mortality rates, at 92 deaths per 1,000 live births (UN IGME, 2014). Vaccines and bed nets rank among the most cost-effective measures to reduce child mortality in SSA, and their increased supply has greatly contributed to a decline of mortality rates (Bloom et al., 2005; Kenny, 2009; Mellor & Freeborn, 2011; Webster et al., 2005). Yet, although often available at low costs, their uptake is far from perfect (Dupas, 2011). In order to bridge the last mile, we need to understand what is holding back uptake. In recent years, scholars have made progress in this direction. Several studies have shown that the demand for preventive healthcare measures is extremely price-sensitive, falls victim to procrastination, and suffers from a lack of information on their cost-effectiveness (Banerjee et al., 2010; Cohen and Dupas, 2010; Dupas, 2009; Hoffmann et al., 2009; Jalan and Somanathan, 2008; Kremer and Miguel, 2007; Madajewicz et al., 2007). The findings call for more subsidies, more incentives for parents to act now rather than later, and more information.

Providing information is crucial because parents cannot empirically observe the efficacy of some healthcare measures (e.g. vaccines), and because learning may be slow and costly for many other measures (e.g. bed nets). Simply receiving information is however rarely sufficient to change behavior (Das and Das, 2003; Dupas, 2011). The message (provider) needs to be perceived as credible. Whether or not this is the case ultimately depends on heuristics – defined as "a simple procedure that helps find adequate, though often imperfect, answers to difficult questions" (Kahneman, 2011: p.102). Heuristics may be based on the observation of comparable outcomes (*Were other – more easily observed – programs of the healthcare provider successful?*), perceptions of the larger system (*Do I trust the public health system?*), the behavior of others (*What are my neighbors doing?*), the opinion of leaders (*What does my (religious) leader say about the*

healthcare provider?) or one's own understanding of disease and healing (*Do the actions of the provider make sense to me?*). Religion may thus affect the demand for healthcare, through the authority of religious leaders or by acting as a frame of reference for evaluating healthcare measures (McCullough and Willoughby, 2009).

That religion affects disease and healing in ways not in tune with conventional medicine is well documented for the main monotheistic religions and their spin-offs.[4] In this paper, we study if and how African Traditional Religion (ATR)[5] affects health behavior and outcomes. ATR's influence may occur through the authority of its religious leaders (who often act as traditional healers) or through its sense-making role, in particular its understanding of disease (as stemming from a conflict with the spiritual world) and healing (as the result of reconciliation with the spirits or ancestors).

While a vast quantitative literature exists on religiosity and health behavior in the West and in the Muslim world[6], there is a lack of quantitative literature on the ATR-health linkage.[7] The gap in the literature is surprising, given the continued high child mortality in SSA and the rising appreciation of behavioral economics as a useful lens for studying health demand in developing

[4] For instance, some groups of Orthodox Protestants in the Netherlands oppose vaccination because of a perceived obligation to trust in Divine Providence (Ruijs et al., 2011). (In)Famous is the Roman Catholic Church's discouragement of condom use (Joshua, 2010; Bokenkotter, 1985). In Islam, there is resistance against vaccines that contain haram substances, such as the anti-meningitis vaccine that includes pork derivatives (Padela, 2013). And, suspicion of the Muslim world against the West hampered vaccination campaigns in Nigeria and Pakistan (Heymann and Aylward, 2004; McGirk, 2015).

[5] The term 'African Traditional Religion' was launched by Parrinder (1954) to denote African beliefs and practices that are religious but neither Christian nor Islamic. While 'traditional' suggests that ATR is a thing of the past, in reality, it is lived and practiced by Africans today (cf. Section 2.1 of this paper). The term 'traditional' needs therefore to be understood as "handed down from generation to generation by the forebears of the present generation of Africans" (Awolalu, 1976).

[6] Regarding the uptake of preventive healthcare measures, the focus lies mainly on opposition against vaccination (see for instance Grabenstein, 2013; Ruijs et al., 2011; Streefland, 2001). Other themes vary widely, including the link between religion and risky health behaviors (e.g. Mellor and Freeborn, 2011), religion and subjective well-being (e.g. Dolan et al., 2008), the health consequences of the Ramadan (e.g. van Ewijk, 2011), and the Muslim advantage in child survival in India (Bhalotra et al., 2010).

[7] There exist a handful of quantitative studies in the medical literature, that include ATR as a regressor when studying health outcomes (e.g. Antai, 2009; Antai et al., 2009; Cau et al., 2013; Gyimah, 2007; Gyimah et al., 2006), but none of these studies explicitly focuses on ATR, nor addresses omitted variable- and endogeneity bias.

countries (World Bank, 2015). Moreover, it stands in contrast with the numerous ethnographic studies on the ATR-health linkage (cf. Section 2). One reason for the lacuna may be related to the dearth of data on ATR beliefs in SSA, and other empirical challenges.

There is widespread under-reporting of ATR adherence which can be traced back to colonial, post-colonial and missionary efforts in SSA to promote monotheistic religion as the only socially acceptable choice (Neill, 1991). Self-reported ATR adherence therefore tends to be a poor measure of actual ATR beliefs and practices. Another empirical difficulty (shared with other religions) is that ATR beliefs are often clustered in space and correlate with several community-, household- and individual-level characteristics, reflecting the location- or ethnicity-specific (historic) spread of religions. This reduces the ceteris paribus variation in ATR and therefore hampers a meaningful quantitative analysis of its relationship with healthcare. Finally, although people often grow up with religion and are thus influenced by parents and their neighborhood (Iannaccone, 1998), religious adherence is to some extent an individual choice because conversion remains possible. Therefore, any analysis of the impact of religious adherence needs to deal with significant endogeneity issues.

In the case of Benin, the first two of these three caveats are less severe, and history provides us with plausibly exogenous variation in self-reported ATR to address the third caveat. First, self-reported ATR in Benin is a uniquely credible indicator for actual ATR-beliefs because Benin's main ATR – Voodoo – is awarded the same status as the monotheistic religions. It is mentioned explicitly in the constitution as an official religion, there is a yearly national Voodoo holiday, and the country is patched with Voodoo convents where Voodoo priests receive training. Because Voodoo is not marginalized socially or politically, people freely report adherence. About 20% of respondents did so in the past Demographic and Health Survey (DHS) rounds. Second, Benin is among the countries with the highest religious diversity and the lowest government restrictions on

religion (Barbier and Dorier-Apprill, 2002; Pew Research Center, 2014a, 2014b). This freedom translates into considerable within-village and within-household variation in religious adherence. For instance, the average DHS survey cluster counts 3 to 4 different religious affiliations for an average sample size of only 24 mothers; and 27% of couples in Benin's DHS do not share the same religious affiliation. Third, the history of Voodoo in Benin is well-documented, among others by missionaries who faced fierce resistance to evangelization by the kingdom of Dahomey and its initial founders, the Adja (see section 2.2). Relying on this recorded history, one can predict the spatial and inter-ethnic group variation in Voodoo that is inherited rather than a result of individual choice.

Armed with these unique empirical advantages and four waves of nationally representative DHS surveys, we quantify the relation between a mother's ATR adherence and two preventive healthcare measures that are known to have a strong impact on child morbidity and mortality: child immunization and the use of bed nets. We also look at two health outcomes: child mortality and malaria incidence. To identify the ATR-health relation, we first control for a large set of potentially confounding observables. In particular, we control for observables at the level of the household (e.g. asset wealth), mother (e.g. education) and child (e.g. age). Moreover, we plug in the entire set of survey cluster dummies to account for confounding supply side factors at the local level.[8] As such, we are always comparing children of ATR adherents to other children in the same community. We find that a mother's ATR adherence is associated with lower uptake of preventive healthcare measures and worse child health outcomes, a finding that is consistent with ethnographic accounts on the impact of ATR on health behavior.

[8] DHS survey clusters correspond to villages in rural areas and city blocks in urban areas.

This need not point to a causal relationship. One concern relates to the poor measurement of household-level income by the DHS proxy for asset wealth. If income is poorly controlled for, it may confound the relation between ATR and health behavior. To deal with this concern, we look at two subsample analyses. First, in the subsample of DHS households where also the husband was interviewed, we control for a husband's religion, thereby isolating the relation between our outcome variables and the ATR adherence of the mother, who is the child's primary caretaker. Second, when studying the use of bed nets, we further abstract from household-level access issues by restricting our sample to bed net owning households. We find that the association between a mother's ATR adherence and our health variables weakens, but remains negative, indicating that we are not merely picking up the influence of household-level confounding factors.

A remaining concern relates to certain characteristics of mother and child that may be poorly measured (e.g. education) or remain entirely unobserved. An example of the latter is a mother's cognitive type: an intuitive rather than an analytical type could imply a "taste for superstition", causing a mother to self-select in certain religions and health systems (e.g. Pennycook et al., 2012; Svedholm et al., 2010). Alternatively, a child may suffer from a chronic and innate poor health condition, that affects its health outcome but could also drive its mother - being disillusioned with the biomedical health system - towards ATR and its traditional healers. To assess the potential threat of these unobservables, our second strategy turns to the procedures developed by Altonji et al. (2005) and refined by Oster (2016) to investigate how much greater the influence of unobservable factors would need to be, relative to observable factors, to completely explain away the negative relationship between ATR and our health measures. Depending on the specification used, we find that the influence of unobservable factors would either have to be between 2 and 5 times greater than observable factors, or almost 10 times greater. The value of

these findings depends however entirely on the unverifiable assumption that the unobservables influence selection in a similar way as the observables.

Because this assumption may not be plausible, we turn to a third strategy to deal with mother- and child-level unobservables. Specifically, to further counter the concern that our results are driven by mothers' self-selection into Voodoo, we instrument a mother's ATR-adherence with a dummy that takes the value one for Adja mothers who currently live within the boundaries of the ancient Dahomey kingdom. The instrument exploits the fact that present-day ATR-adherence is not merely an individual choice, but is shaped by history and tradition, most notably by the fierce resistance of the ancient Dahomey kingdom and its Adja founders against evangelization (cf. section 2). The IV-results provide further evidence to support the claim that the ATR-health relationship is not entirely confounded or driven by self-selection. We conclude that, while much of the relation between ATR and health is spurious, a non-negligible part of it is extremely robust to empirical scrutiny, suggesting a causal pathway between ATR and health.

As mentioned above, this causal pathway may be mediated by a certain belief system, or by ATR leaders. The worldview embedded in African cosmology does not seem to be the driving factor: the negative ATR-health relation is ATR specific, and not akin to African cosmology in general as we do not find a relation between the uptake of conventional healthcare measures and the adherence to African Independent Churches, or the belief in witchcraft. A tentative exploration of the role of traditional healers, often taken up by Voodoo priests, indicates that ATR-mothers rely more on traditional healers and – when they do – make less use of conventional medicine.

Before turning to the empirical analysis, we provide background information on ATR, Voodoo in particular, and its relation with traditional and conventional healthcare.

2. Background

2.1. African Traditional Religion, African cosmology and healthcare

ATR beliefs and practices are firmly rooted in African cosmology[9], which is characterized by a continuum between the visible and invisible world (Geschiere, 2013). Whether manifested in ATR or witchcraft beliefs, an essential characteristic of African cosmology is the day-to-day intimacy with the spiritual world: ancestors-turned-spirits can directly affect your life, living family members can turn to occult forces to bewitch you, and your local pharmacist may be your religious leader (Geschiere, 2013). The intimacy between the physical and spiritual world shapes the cultural understanding of illness and healing in SSA. A disease is often not seen as a consequence of a virus, parasite or malfunctioning of the body, but as the result of witchcraft, attacks by evil spirits or a conflict between humans and their ancestors (Maslove et al., 2009; Omonzejele, 2008). To be effective, disease prevention and treatment should include contact with the spiritual world, through divination (the consultation of spirits) and sacred rituals. Only then can harmony between the spiritual and physical world be maintained or restored, and the disease prevented or cured.

Conventional medicine and its products, being solely focused on the physical world, may not easily take root in such a belief system. Numerous qualitative studies have indeed argued that African traditional beliefs affect the demand for healthcare, and that conventional health programs should take these beliefs into account to improve their effectiveness (Aikins et al., 1994; Comoro et al., 2003; de Sousa et al., 2011; Kale, 1995; Maslove et al., 2009; Muela et al., 1998). These arguments were further underlined in research on HIV/AIDS prevention and treatment (Awusabo-Asare and Anarfi, 1997; Kalichman and Simbayi, 2004; Thomas, 2007; Van Dyk, 2001), and also

[9] Although Africa's cosmology is diverse, the literature has distinguished a core of shared beliefs which may be said to constitute 'African' cosmology (Akoto and Akoto, 2005; Awolalu, 1976; Kanu, 2013; Nyang, 1982).

the recent Ebola outbreak in West-Africa gave way to a similar discussion.[10] In contrast to conventional medicine, traditional healers provide health services that are consistent with the local magico-religious understanding of illness and health.[11] There is wide consensus that such healers have considerable authority and influence in SSA, playing an important role by providing traditional healthcare based on sacred rituals and medicinal plants, and – in some cases – by rejecting conventional medicine (e.g. Aujoulat et al., 2003; Maslove et al., 2009; Soumonni, 2012; WHO, 2012).

Apart from ethnographic studies, a systematic data collection project on spiritual life in SSA documents the wide prevalence of magico-religious beliefs and practices (PEW Research Center, 2010). Among the 25,091 respondents of 19 SSA countries in the PEW dataset, a large share mentioned having consulted a traditional healer (42.4%), believing in witchcraft (45.6%) and evil spirits (50.6%), and believing that "sacrifices to spirits or ancestors can protect you from bad things happening" (33.0%).[12] Most of the respondents are however self-reported Christians or Muslims; only 2% mentioned ATR as their religious affiliation. In most SSA countries, self-reported ATR adherence thus tends to be a poor proxy for the beliefs and rituals that are characteristic of traditional African religions. It is likely to be a much better proxy in Benin.[13] In Benin's four DHS rounds, about 20% of respondents report ATR as their religious affiliation. For

[10] See for instance: BBC (2014), IFRC (2014) and Telegraph (2014).

[11] Some authors also argue that traditional healers appeal to the public in another way, i.e. by offering outcome-contingent contracts (Leonard and Zivin, 2005). The enforcement of this contract hinges on the patient's fear of the power of traditional healers (who may curse them when they do not respect their payment obligations).

[12] The 19 countries are: Botswana, Cameroon, Chad, DR Congo, Djibouti, Ethiopia, Ghana, Guinea Bissau, Kenya, Liberia, Mali, Mozambique, Nigeria, Rwanda, Senegal, South Africa, Tanzania, Uganda and Zambia.

[13] Self-reported ATR adherence is likely to be a better proxy in countries with relatively high self-reported ATR adherence. In the full PEW sample, ATR adherence is significantly correlated with the practice of visiting traditional healers, witchcraft beliefs, belief in evil spirits, and sacrifices to ancestors – but the correlation coefficients are rather low, at 0.13, 0.10, 0.07 and 0.20 respectively. In Liberia, the PEW sample country with the highest self-reported ATR adherence (12%), the correlation coefficients are much higher, at 0.35, 0.50, 0.40 and 0.53 (own calculations from PEW dataset).

the vast majority of these respondents, ATR adherence equals adherence to Voodoo, which is Benin's main traditional religion.

2.2. The rise, fall and renaissance of Voodoo in Benin

Voodoo became the dominant religion in Benin in the 17th century as a result of the supremacy of the Dahomey kingdom (Janssen, 2010; Law, 2004; Tall, 1995). The Dahomey kingdom was founded by the Adja, who migrated from Togo to southern Benin around the 13th century (Bourgoignie, 1972; Glele, 1974; Herskovits, 1938; Le Hérissé, 1911). Dahomey became one of the most powerful kingdoms along the West-African coast and its warfare and slave trade activities gave way to a fusion of religious beliefs and practices from various ethnic groups. This fusion led to the development of Voodoo as a 'new' supra-clan religion (Geschiere, 2013; Manning, 1982; Soumonni, 2012). Voodoo priests took up powerful positions in the kingdom, and advised the king to resist evangelization. As a result, conversion to Christianism was made punishable by the death penalty and missionaries faced restricted access to the kingdom (Dupuis, 1998: p.90, p.96-97, p.113, p.159, p.166, p.220, p.243). In his "Histoire de l'église du Bénin" father Paul-Henry Dupuis concludes that "Dahomey remained the least welcoming, the most 'closed' of all the kingdoms in the Gulf of Guinea"[14] (Dupuis, 1998, p. 220).

In the 19th and 20th century, under colonial rule and post-independence Marxist-Leninist dictatorship, Voodoo and other ATR in Benin were marginalized and socially stigmatized, much like in other SSA counties. For instance, in 1976, an 'anti-witchcraft' law was put in place, which was especially harmful to Voodoo priests who risked being persecuted. The intimidation led to a sharp decline of self-reported Voodoo adherents and a promotion of monotheistic religions,

[14] Own translation from "le Dahomey restait le moins accueillant, le plus 'fermé' de tous les royaumes de ce Golfe de Guinée".

although ATR influences survived, leading to considerable religious syncretism (Barbier and Dorier-Apprill, 2002; Tall, 1995a). The advent of democracy, in the early 1990s, allowed ATR to resurface in Benin. The new democratic leadership promoted Voodoo as part of a (new) national identity, but also because of political opportunism, to win votes in the democratic elections through the support of traditional religious leaders (Mayrargue, 1995; Tall, 1995b). In 1992, Voodoo became enlisted in the constitution as an official religion and received its own public holiday, on January 10. Presently, Voodoo is widely cherished as a national heritage, preached openly by voodoo priests, and further cultivated in Voodoo convents.

The exceptional renaissance of ATR in Benin allows us to safely assume that self-reported ATR adherence in Benin is a reasonably good proxy for ATR beliefs. It is however by no means a perfect proxy. The religious landscape in Benin is characterized by great syncretism, and Voodoo faces competition by African Independent Churches that blend Christian traditions with ATR-like rituals, miracles and charismatic healing (Barbier and Dorier-Apprill, 2002; Olupona, 2014; Tall, 1995a). We will return to this syncretism in the empirical analysis.

2.3. Voodoo and healthcare in Benin

Similar to other ATR adherents, Voodoo adherents believe that the dead turn into spirits who interact with humanity, playing a significant role in human destiny and wellbeing (Bourgoignie, 1972).[15] Several studies indicate that Voodoo's powerful traditions and mystic beliefs constitute obstacles to the demand for healthcare in Benin. Aujoulat et al. (2003), for instance, argue that cultural beliefs in southern Benin affect the demand for treatment of Buruli ulcer, a skin infection

[15] Some of the dead can gain the high status of deified ancestors and become protectors of the clan. Higher up in the cosmologic hierarchy are several deities which are ambivalent beings (good/evil) that relate to different natural elements (e.g. gods of the earth, sky, water, iron, forests). What distinguishes Voodoo from mere ancestor worship or animism is the recognition of a Supreme Being (Mawu or God), who leads the cosmologic hierarchy but does not concern itself directly with man. The communication with Mawu passes through the worship of deities. Especially feared is Sakpata, the Voodoo of the earth, who inflicts disease on humans (Henry, 2010; Soumonni, 2012).

which can lead to disfigurement and disability. Magico-religious beliefs in Benin are also said to affect malaria prevention and treatment (Rashed et al., 1999; de Sousa et al., 2011), and have been blamed for a low demand for vaccines, because some traditional healers have advised against their use (ONE, 2011a, 2011b; Soumonni, 2012).[16] Magico-religious beliefs do not always go against conventional medical prescriptions. For instance, Jenkins and Curtis (2005) argue that such beliefs are a motivation for latrine adoption in Benin, among others because of "fear of enemies stealing your feces for sorcery against you".

According to a WHO (2002) report on traditional medicine, up to 80% of the Beninese population relies on traditional healers for their primary healthcare.[17] This reliance is stronger among Voodoo adherents. For instance, LeMay-Boucher et al. (2013), studying magico-religious expenditures in Benin, find that self-declared Voodoo adherents report significantly higher such expenditures compared to individuals from other religious groups. If these expenditures act as a substitute for conventional health care, we expect to find a negative relation between ATR adherence and the uptake of bed nets and vaccines.

3. Data description

We pool data from four DHS surveys, conducted in 1996, 2001, 2006 and 2012. All surveys are nationally representative, covering the six provinces of Benin.[18] Geographic stratification was based on survey clusters, corresponding to villages in rural areas and city blocks in urban areas.

[16] The campaigning and advocacy organization ONE collaborated with VBS television network on a documentary about the relationship between Voodoo and conventional medicine in Benin. The documentary points to the importance of traditional healers, who are among the most respected members of society and have considerable authority. Dr. Roch Hougnihin, director of the national program of traditional medicine in Benin, argues that "if village traditional healers are opposed to vaccination, parents will not allow their children to be vaccinated"(Gerson, 2011; ONE, 2011a, 2011b).

[17] This may, in part, be due to supply side issues: it is estimated that Benin has only one doctor for each 10,000 individuals, but one traditional healer for each 800 individuals (Ministère de la santé, Benin, 2008, p.7).

[18] The six provinces were transformed into 12 departments by an administrative reorganization in 1999.

Information collection in DHS mostly concerns children younger than 6 years and their mothers. Our sample is composed of 35,121 children, from 23,801 households and 1,777 survey clusters, for whom information is available on the mother's socio-demographic characteristics. Information on father's characteristics is only available for a subsample of 6,533 households. Mothers are on average 29 years old, while fathers are on average 37 years old. The level of parents' education is generally low, averaging about 1.4 years of schooling for mothers and 3 years for fathers. Parents in our sample are mainly Fon (41%) or Adja (16%); others belong to one of six smaller ethnic groups. These and other summary statistics are presented in Table A.1 in the supplementary appendix. In what follows, we provide a brief description of religion and health in the DHS data, and how they relate to each other.

3.1. Religion

Table 1 reveals that 19% of mothers in our sample report to be ATR adherents (85% of which are Voodoo-adherents)[19]; other important religious affiliations among mothers include Catholicism (26%), Islam (24%), Protestantism (6%) and other Christian churches (18%). The other Christian churches include Anglo-American variants as well as African Independent Churches, most prominently the Celestial Church (Barbier and Dorier-Apprill, 2002).

Despite regional differences, all religions are practiced throughout the country. Within DHS survey clusters there is large religious heterogeneity: the average cluster counts just 24 mothers, but includes more than 3 different religious affiliations; and about half of the 1,777 survey clusters included in our analysis comprise both ATR and other mothers. Even within households we find substantial religious heterogeneity: in 27% of the 6,533 households for which we have information

[19] The share of 85% is calculated from the 2006 and 2012 DHS survey rounds, which are the only rounds that distinguish between Voodoo and 'other traditional religions'.

on both parents, the parents do not have the same religious affiliation (see Table 1); and in almost half of the 1,825 couples in which at least one partner reports to be an ATR adherent, the other partner belongs to a different religion.

Several descriptive statistics indicate that individual ATR-adherence is not just determined by individual choice, but also by history and tradition. First, the share of ATR-adherents is much higher among the descendants of the founders of the Dahomey kingdom: about half of Adja mothers (47%) and fathers (57%) are ATR-adherents versus 13% and 18% among mothers and fathers from other ethnicities (see Panel A of Table 2). Furthermore, parents currently living within the boundaries of the ancient Dahomey kingdom are significantly more likely to be ATR-adherents – whether they belong to the Adja ethnicity or not (see Panel B of Table 2).[20]

3.2. Health

A child is fully immunized if it received all eight vaccines which are required by the WHO Expanded Program on Immunization, protecting the child among others from polio, tetanus, and measles.[21] It is recommended that children are fully immunized by the age of one. In our sample, we have information on 26,359 children aged 1-5 for which we have data on vaccination rates and the socio-demographic characteristics of their mother. Table 3 shows that the first-time vaccination rates are fairly high for the individual vaccines – between 60% and 90%. The full immunization rate is driven down by a failure of subsequent vaccinations. For instance, vaccination rates for the second and third vaccine of DPT and polio are about 10 and 20 percentage points lower compared

[20] Historical maps from Dupuis (1998) indicate that the boundaries of the ancient Dahomey kingdom roughly corresponded to the present-day departments Atlantique, Kouffo and Zou – located in the South-West of Benin (see Figure 1).

[21] Routine immunization schedules in Benin stipulate that infants should be vaccinated with: (1) a dose of Bacillus Calmette-Guerin (BCG) vaccine at birth; (2) three doses of diphtheria, pertussis and tetanus (DPT) vaccine at 6, 10 and 14 weeks after birth; (3) at least three doses of oral polio vaccine (OPV) at birth and at 6, 10 and 14 weeks after birth; and (4) one dose of measles vaccine 9 months after birth.

to the first. Because of the incomplete uptake of the various vaccines, full immunization rates in Benin are dangerously low, at only 37% in the latest DHS round (2012).[22] In order to turn the tide and sustain progress in immunization coverage rates, Benin relies on large-scale immunization campaigns. Distribution posts go from village to village and health workers go from door to door in an attempt to reach all children, especially those in remote areas. In 2009 about 2.7 million children under the age of five were to be vaccinated during two rounds of National Immunization Days (UNICEF, 2009). The negative side-effect is that mothers do not spontaneously bring their children to health centers to get them vaccinated. They rather wait for health workers to pass by their house (INSAE, 2013, 2007). This perverse effect may have contributed to the decline in immunization rates in the past decade (see Panel A of Table 3).

To combat malaria, Benin organized large-scale campaigns in 2007 and 2011. Almost 6 million long lasting insecticide nets were distributed (INSAE, 2013). This explains the rising trend in bed net ownership and use, shown in Panel B of Table 3. Household ownership of bed nets doubled from 44% in 2001 to 90% in 2012, when 3 in 4 bed nets were obtained from a distribution campaign. Over the same period, the share of households in which *all* children slept under a bed net the night before the interview increased from 35% to 74%; and between 2006 and 2012, the share of children who slept under a treated net increased from 30% to 89%. Malaria nevertheless remains a major issue in Benin. In 2012 it was reported to be the main cause of under-5 mortality and responsible for nearly half (42%) of hospitalizations of children under five (INSAE, 2013). During the 2012 DHS round, a malaria blood test was administered on children of 6 to 59 months old. Among the 3,134 children in our database that were tested, 26% tested positive.

[22] When considering the 34 Sub Saharan African countries where the most recent DHS survey was organized between 2006-2015, full immunization rates range from 24% to 93% with an average of 60% (DHS, 2017).

Overall, substantial progress in health outcomes has been made over the past decades. The neonatal-, infant-, and under-five mortality rates have all decreased between 1996 and 2012. For instance, under-five (and infant) mortality rates more than halved, from 166 (99) deaths per 1,000 live births in 1996 to 67 (43) deaths in 2012 (see Panel C of Table 3).

3.3. Correlation between ATR and healthcare

In Table 4 we present the simple two-way relationship between mothers' ATR adherence and the uptake of preventive healthcare measures. The results indicate that children whose mother is an ATR adherent are less likely to be fully immunized (37% compared to 44%) and more likely to have received none of the eight vaccinations required by the WHO (15% compared to 10%). Children of ATR mothers are also less likely to live in a household that owns a bed net (56% compared to 74%), and even when the household owns a bed net they are less likely to sleep under it (73% compared to 80%). The differences are all statistically significant at the 1%-level. Turning to health outcomes, the results in Table 4 indicate that children whose mother is an ATR adherent are more likely to test positive for malaria (40% compared to 23%) and have a higher risk of dying, as indicated by significantly higher neonatal-, infant- and under-five mortality rates. As these bivariate correlations may be contaminated by confounding factors, we now turn to a multivariate regression analysis.

4. Accounting for observables

Informed by ethnographic studies, we hypothesize that *ATR adherence reduces household uptake of conventional healthcare measures and worsens health outcomes*. We test this hypothesis for Benin because ATR adherence in Benin is freely reported and varies considerably within villages and within households. However, we still face two major empirical challenges.

First, even in Benin, self-reported ATR adherence is by no means a perfect proxy for traditional religious beliefs. There still is a fair amount of underreporting, especially in the northern part of the country where Islam dominates, and there is lots of religious syncretism, which goes unnoticed in the DHS as it only asks about the primary religious affiliation. Besides, ATR does not have a monopoly on beliefs and practices that go against conventional medicine. In particular, Charismatic Churches and African Independent Churches also put a lot of emphasis on spiritual healing. Combined, these features imply that, when estimating the relation between ATR adherence and conventional healthcare, our control group (no self-reported ATR adherence) is contaminated by both ATR- and non-ATR related beliefs that also affect the demand for healthcare. Our estimated relation will therefore be a lower bound.

Second, ATR correlates significantly with several community-, household- and individual-level characteristics. As such, households in which the mother is an ATR adherent are more likely to live in rural areas (81% vs 62%) and tend to be less wealthy (see Table 5). ATR mothers are also more likely to live in a polygamous household (51% compared to 38%) and ATR adherents are less educated; a finding that holds both for mothers (0.4 years of schooling compared to 1.6 years) and fathers (1.6 years compared to 3 years).

To account for these confounding factors, we include the entire set of survey cluster dummies as well as a large set of socio-economic characteristics. Formally, the empirical model can be written as follows:

$$y_{cmhv} = \alpha_0 + \alpha_1 \, ATR_{mhv} + I'_{cmhv} \, \Omega + I'_{mhv} \, \mathrm{E} + H'_{hv} \Delta + DHS'_v \, \Gamma + V'_v \, \Lambda + \varepsilon_{cmhv} \quad (1a)$$

$$y_{mhv} = \alpha_0{}' + \alpha_1{}' \, ATR_{mhv} + I'_{mhv} \, \Omega' + H'_{hv} \Delta' + DHS'_v \, \Gamma' + V'_v \, \Lambda' + \varepsilon_{mhv} \quad (1b)$$

where c indexes children, m mothers, h households and v DHS survey clusters. In Equation (1a) children are the units of observation, and the outcome variables, denoted by y_{cmhv}, are 'not having received any vaccines', 'full immunization', 'the use of bed nets', and 'malaria incidence'. In Equation (1b), mothers are the unit of observation and the outcome variables are 'bed net ownership' and 'child mortality', denoted by y_{mhv}. The sample size in the regressions varies depending on the unit of observation (children or mothers) and the availability of data (e.g. information on bed nets was not collected in the 1996 DHS survey, and the malaria test was only administered in the 2012 DHS survey).

The main explanatory variable is mothers' adherence to ATR, captured by ATR_{mhv} which is a dummy variable that takes the value one if the mother of the child reports to be an ATR adherent.[23] I_{cmhv}, I_{mhv} and H_{hv} are vectors containing child-, mother- and household-level covariates which are likely to influence the uptake of conventional healthcare measures. At the level of the child, we include: gender, age (in months), and a birth-order and -interval variable.[24] We control for the mother's age, age at first birth, years of schooling, and her ethnicity. At the household level we include wealth quintiles [25], a dummy indicating if the household is polygamous, and the number of children under five. The model also controls for the year in which the DHS

[23] The DHS data only record reported affiliations, not the intensity of religious participation (e.g. frequency of ceremony attendance, prayer, etc.).

[24] Studies have shown that birth order and the time between births matter for the vaccination of children. We merged the DHS variables "birth order" and "preceding birth interval" into one variable. In doing so, we follow the categorization of (Antai, 2010): (1) first births; (2) birth order 2-4 with short birth interval (<24 months); (3) birth order 2-4 with medium birth interval (24-47 months); (4) birth order 2-4 with long birth interval (48+ months); (5) birth order 5+ with short birth interval (<24 months); (6) birth order 5+ with medium birth interval (24-47 months); and (7) birth order 5+ with long birth interval (48+ months)

[25] We calculated a wealth index as the first principal component of a large number of household assets including: source of water, type of toilet facility, type of floor/wall/roof-material, and the ownership of radio, television, telephone, refrigerator, car. From the index we calculated wealth quintiles that range from 1 to 5 with a mean value of 2.8 and a standard deviation of 1.36. We control for the wealth quintiles as it allows for an easier interpretation, but all results are robust to controlling for the wealth index in levels.

survey took place (DHS_v) and the survey cluster in which the household lives (V_v); α_0 is a constant, ε_{chv} and ε_{mhv} are error terms.

Following Angrist and Pischke (2009: p.102-107), we estimate the equations using a Linear Probability Model (LPM). As a robustness check, we compare the LPM estimates to marginal effects estimated by a Logit model. Standard errors are clustered at the household level to account for within-household correlation of the residuals.[26]

In Table 6 we look at the determinants of not having received any vaccination among children aged 1-5.[27] We present five models, going from parsimonious to more inclusive specifications. In the first column we only control for the survey year and the geographical department. We find a large and significantly positive coefficient estimate on ATR adherence indicating that children whose mother is an ATR adherent are 8 percentage points more likely not to have received a single recommended vaccination. When adding cluster fixed-effects in the second column, the ATR effect is reduced considerably suggesting that local- or supply-side factors are important confounding factors. Adding controls for individual- and household-level characteristics further reduces the estimated ATR effect (see columns 3-5). We find a similar change in estimated coefficients across parsimonious and more inclusive specifications when looking at the determinants of full immunization, and the ownership and use of bed nets (Columns 2-4 in Table 7 report the inclusive model specifications while the full set of model specifications can be consulted in Tables A.2-A.4 in the supplementary appendix).

[26] Following Cameron and Miller (2015), we progressively clustered the standard errors at broader levels. In our baseline estimates, reported in the paper, we chose to cluster the standard errors at the household-level because equations (1a) and (1b) include several household-level controls. All results are however highly robust to clustering the standard errors at the level of the survey clusters (see infra and Table A.7 in the supplementary appendix).

[27] As explained in section 3.2, it is recommended that children are fully immunized by age one. When analyzing the determinants of vaccination, we therefore consider children aged 1-5 rather than children aged 0-5.

Even when controlling for the full set of socio-economic characteristics and when comparing children within the same survey cluster, we find that children with an ATR mother are 3 percentage points more likely not to have received any vaccine (13% vs 10%), 3 percentage points less likely to be fully immunized (40.5% vs 43.3%), 6 percentage points less likely to live in a household that owns a bed net (65% vs 71%) and 6 percentage points less likely to sleep under a bed net (61% vs 67%) (see Columns 1-4 in Table 7). Overall, the estimated ATR effects are larger than the effect of an additional six years of schooling for the mother or a change from the first to the second household wealth quintile. The signs on the control variables are generally in line with our expectations.[28]

In columns 5-6 of Table 7 we turn to the determinants of health outcomes (we present the inclusive specifications, and report the more parsimonious ones in the supplementary appendix, in Tables A.5 and A.6). Column 5 presents the estimated determinants of malaria incidence, obtained from blood tests administered in the 2012 DHS survey, indicating that children whose mother is an ATR adherent are 6 percentage points more likely to test positive for malaria (32.5% vs 26.9%) – even when controlling for bed net ownership. The results in Column 6 indicate that the under-five mortality rate for ATR mothers is higher with approximately 9 deaths per 1,000 live births compared to non-ATR mothers (90.8 vs 81.7).

In sum, when adding socio-economic characteristics and especially cluster fixed-effects to the model, the ATR effect gradually diminishes. However, even in the inclusive specifications,

[28] For instance, living in a richer household and having a more educated mother significantly improves children's uptake of preventive healthcare measures.

ATR adherence of the mother remains significantly associated with a lower uptake of preventive healthcare measures and worse child health outcomes.[29]

5. Accounting for unobservables

The above estimated ATR-health relationship may be spurious. First, while the survey cluster dummies control for the supply of health care at the level of the village or city block, they do not control for effective household access to various health facilities, e.g. related to a household's financial wealth. In our estimating equations wealth is proxied by an asset index, which is far from perfect.

Second, mothers could self-select into ATR for various reasons. One reason relates to cognitive style. For instance, an intuitive cognitive style, as opposed to a more analytical one, predicts religious beliefs, paranormal beliefs, anthropomorphism and attitudes towards alternative medicine (e.g. Pennycook et al., 2012; Svedholm et al., 2010). In other words, some mothers may have a 'taste for the supernatural', thus self-selecting both in ATR and other-than-biomedical medical forms of healing. Another driver of self-selection may relate to the health history of the mother or of one of her children. Chronic or mental illness, or an unexpected death, generally

[29] These results are robust to clustering the standard errors at the level of the survey cluster (see Table A.7 in the supplementary appendix) and to the inclusion of DHS sample weights (results not reported but available upon request). The same holds for all other results presented in the paper. In Table A.8 we further compare the results estimated with LPM and Logit models. In order to make the samples comparable, we restrict the LPM estimates to survey clusters that have variation in the dependent variable (Beck, 2015). To calculate marginal effects after the Logit estimations we use the procedure suggested by Beck (2015): We first estimate the regression coefficients with a conditional logit model (clogit); then we run a fixed effects logit model, constraining the coefficients to those estimated by clogit, from which we calculate the marginal effects. The thus calculated marginal effects are highly comparable to the constrained LPM estimates. In addition, in Table A.9 in the supplementary appendix, we estimate equations 1a and 1b for each DHS survey year separately. Although the results do not allow us to say much about the evolution of the ATR-effect over time (due to a lack of data availability and relatively small sample sizes in some survey years), the ATR-health relationship seems to be persistent over time and is relevant in the latest DHS survey round of 2012. Finally, we explore heterogeneity in the ATR-effect by interacting a mother's ATR-adherence with (1) her level of education; (2) a dummy indicating if a mother is literate; and (3) the household wealth quintiles. None of these specifications yield a significant interaction term however (results not reported but available upon request).

trigger more suspicion of supernatural causes than other medical conditions or misfortunes. A typical example is epilepsy, which is strongly associated with spirit possession (Carrazana et al., 1999; Khoury, 2012). Children suffering from epileptic seizures, or other chronic health conditions, may be confined to Voodoo convents. The innate health condition of the child may thus be a possible confounder, affecting both our outcome variable and explanatory variable of interest.

We adopt three strategies to determine whether the ATR-health relation is causal, rather than driven by various unobservables.

5.1. Subsample analysis: bed net owners and father's characteristics

To better rule out the influence of financial wealth, we look at two subsamples. First, when estimating the determinants of bed net *use*, we confine the sample to bed net *owning* households. Second, we consider the subsample of 6,533 households for which we have information on both parents. This allows us to control for a father's ATR-adherence. If mother-specific factors rather than household-level factors drive our ATR estimate, we should find that ATR adherence of the mother has a larger effect on our outcome variables than ATR adherence of the father, because women in Benin have the primary responsibility when it comes to children's healthcare decisions (de Sousa et al., 2011; ONE, 2011b; Rashed et al., 1999).

The results in column 1 of Table 8 indicate that even when comparing households with similar socio-economic characteristics, who live in the same survey cluster *and* who own a bed net, children of ATR mothers are 3 percentage points less likely to actually sleep under the bed net (82.5% vs 85.5%). In columns 2-7 of Table 8, we control for the father's characteristics (his ATR adherence, age, years of schooling and ethnicity) and still find a large and significant negative

relation between mother's ATR adherence and the uptake of all preventive healthcare measures.[30] In contrast, for father's ATR adherence we only find a slightly significant negative relation with the ownership and use of bed nets. With respect to health outcomes, we find that only mother's ATR adherence is associated with higher child mortality and a higher incidence of malaria among children, although this relation is no longer significant.[31] These results indicate that the ATR-health correlation is specific to the mother of the child, reducing concerns that household-level characteristics associated with ATR-adherence are driving the results.

5.2. Using Selection on Observables to Assess the Bias from Unobservables

To further assess the influence of unobservables, we turn to the approach proposed by Altonji et al. (2005) and fine-tuned by Oster (2016). The approach uses the selection on observable variables as a guide to assess the potential bias from unobserved variables. Put very simply: if adding a battery of *relevant* observables does not affect our coefficient of interest much, then it is unlikely that there exist many unobservables that would completely cancel out our result.

The selection on observable variables can be evaluated by looking at coefficient movements in the ATR-estimate while gradually adding additional control variables; their relevance is assessed by the associated movements in the R-squared. Based on these insights, Oster (2016) develops a measure that indicates how large selection on unobservable variables has to be, relative to selection on observables, to fully explain away the estimated effect. In Appendix A.10, we detail how we implement the procedure in our setting. We find that selection on unobservables would need to be

[30] The estimated ATR-effects are even slightly higher compared to those estimated in Table 7: children whose mother is an ATR-adherent are 12 percentage points more likely not to be vaccinated, 8 percentage points less likely to be fully immunized, 11 percentage points less likely to own a bed net and 11 percentage points less likely to sleep under a bed net.

[31] When interpreting the results on health outcomes, one should take into account that the sample of children tested for malaria is relatively small – especially within this subsample of observations with information on both parents – and that the death of a child is a relatively rare event.

about twice as large as selection on observables to fully explain away the estimated ATR-effects reported in Table 7. Moreover, when additionally including father's characteristics, the results suggest that selection on unobservables would need to be 12.0, 9.4 and 9.0 times as large as selection on observables to fully explain away the estimated ATR-effects (reported in Table 8) on 'not having received a single vaccination', 'full immunization' and 'under 5 mortality'.

Overall, these findings suggest it is unlikely that the ATR effect is entirely driven by omitted variable bias. On the other hand, the value of the test depends entirely on the unverifiable assumption that the unobservables influence selection in roughly the same way as the observables. Because this assumption may not be plausible, we turn to a third strategy to deal with unobservables.

5.3. Instrumental variable approach

This strategy exploits the fact that present-day ATR-adherence is shaped by history and tradition. We instrument a mother's ATR-adherence with a dummy that takes the value one for Adja mothers who currently live within the boundaries of the ancient Dahomey kingdom. The instrument is a relevant predictor of a mother's ATR-adherence: the Adja in our sample are the descendants of the initial founders of the Dahomey kingdom, where Voodoo originated and evangelization was strongly resisted (see Section 2.2). These historical relationships still influence present-day ATR-adherence: Adja mothers are significantly more likely to be ATR-adherents, and this is even more apparent for Adja mothers currently living within the boundaries of the ancient Dahomey kingdom (see Section 3.1).[32]

For the exclusion restriction to be satisfied, the instrument should only impact the outcome variables through a mother's ATR-adherence. The exclusion restriction is violated if there exist

[32] 53% of the 3,888 Adja mothers in our sample currently live within the boundaries of the ancient Dahomey kingdom.

certain (cultural) traits specific to the Adja ethnicity, that are associated with the outcome variables but are not captured by a mother's ATR-adherence. As Voodoo originated from and further shaped the Adja culture, we argue that – conditional on the included control variables – the exclusion restriction is defendable in this respect. A second concern is that, due to e.g. geographical reasons, the outcome variables might be directly affected by living within the boundaries of the Dahomey kingdom. We implement two strategies to address this concern. First, we additionally control for a set of geography-related covariates (i.e. a dummy indicator for rural areas, a dummy indicator for the geographical South of Benin, the survey cluster latitude and longitude, and the survey cluster distance to the closest city).[33] Second, we run two sets of IV regressions: one within the full sample, and a second in which we restrict the sample to the Southern departments of Benin – which are geographically closely related to the Dahomey kingdom.[34]

The first-stage results, presented in column 1 of Table 9, indicate a strong and significant relationship between our instrument and a mother's ATR-adherence: both in the full sample and when restricting the sample to the Southern departments we find that Adja mothers who currently live within the boundaries of the Dahomey kingdom are about 35 percentage points more likely to be ATR-adherents. Moreover, the first-stage F-tests are large and significant, giving further confidence that the instrument is sufficiently relevant. The second-stage results are presented in columns 2-8 of Table 9. It is important to keep in mind that they capture the local average treatment

[33] In the IV regressions we no longer add survey cluster fixed effects, as this would absorb much of the variation in our instrument. To assess the strength of the geography-related covariates we run two sets of LPM regressions: one in which we control for the baseline covariates (all those reported in Table 7) and the geography covariates, but without adding cluster fixed effects – and another in which we additionally add cluster fixed effects. We do not find a statistically significant difference between both sets of ATR-effects (except for the malaria test results), indicating that the geography covariates provide a reasonable proxy for local unobserved covariates (results not reported but available upon request).

[34] The South of Benin counts seven departments: Atlantique, Kouffo, Littoral, Mono, Ouèmè, Plateau and Zou (see Figure 1). Although they cover a relatively small surface area, about 60% of the sample lives in these Southern departments. The South of Benin differs from the North, both in terms of geography (e.g. the South is characterized by its large lakes and lagoons) and culture (e.g. in the Northern departments about 50% of our sample reports to adhere to Islam, while this is only the case for 6% in the South).

effect, i.e. they are driven by the variation in a mother's ATR-adherence caused by the instrument; and additionally deal with attenuation bias (not unimportant given the high religious syncretism). With respect to preventive healthcare measures, the estimated ATR-effects are in line with those reported in Tables 7 and 8: we find that children whose mother is an ATR-adherent are 14 percentage points more likely not to have received any of the eight recommended vaccines; 15 percentage points less likely to live in a household which owns a bed net; and 11 percentage points less likely to sleep under a bed net (even if the household owns one). With respect to health outcomes: the ATR-effect is no longer significant for the under-5 mortality rate, while it is large and highly significant for the malaria test (indicating that children whose mother is an ATR-adherent are almost 50 percentage points more likely to test positive for malaria). The first- and second-stage IV results remain qualitatively unchanged when running the estimation on the full sample or when restricting the sample to the South of Benin, suggesting that local geography is not a strong mediating channel between the instrument and our outcome variables.

6. Testing for Channels of Causality: world view Versus traditional healers

Overall, the results of the three strategies discussed above indicate that the ATR-health relationship is not entirely spurious. In this section, we explore two main channels through which ATR may influence heuristic decision making about healthcare measures: the ATR worldview and the reliance on traditional religious leaders.

6.1. The ATR worldview

ATR adherence may promote a worldview that is not conducive to the uptake of conventional healthcare treatments. As explained above, this worldview is akin to African cosmology. If the worldview is the mediating channel, we would therefore expect that other beliefs that strongly

relate to African cosmology are also associated with lower uptake of conventional healthcare measures. To test for this possibility, we look more closely at African Independent Churches and witchcraft beliefs.

The DHS records adherence to African Independent Churches in the response category 'other Christian religions'. Regarding witchcraft beliefs, the DHS data includes one single proxy, i.e. whether a mother believes that HIV/AIDS can be transmitted by witchcraft. This question was only asked in the 2006 and 2012 DHS surveys. Table 10 shows that on average 48% of the mothers in our sample believe in HIV/AIDS-transmission through witchcraft. Among ATR mothers the belief is slightly higher, at 52% but it is highest (56%) among mothers from 'other Christian religions'. Especially Pentecostal and Celestial churches are known for their explicit recognition of and fight against witchcraft (Casanova, 2001; Geschiere, 2013).

In Table 11 we replace mother's ATR adherence with a dummy indicating mother's adherence to 'other Christian religions' as the variable of interest. The results indicate that, in terms of preventive healthcare and health outcomes, children of these mothers are not significantly different from other children (although they are slightly *more* likely to live in a household that owns a bed net). In Table 12, we add the variable $Witchcraft_{mhv}$, a dummy indicating if the mother believes that HIV/AIDS can be transmitted by witchcraft, as an explanatory variable. For each outcome variable, we compare the estimates with and without this dummy, restricting the sample to the observations for which the belief was reported. The results indicate that this belief does not have an important effect on the preventive healthcare measures we study, neither does it influence whether children test positive for malaria. We do find a significantly higher under-five

mortality rate for mothers who hold this belief (see column 12).[35] Most importantly, the coefficient related to ATR adherence is hardly affected by the inclusion of a mother's witchcraft beliefs.

The insignificance of 'other Christian religions' and the robustness of the ATR coefficient to the inclusion of witchcraft beliefs suggest that the mediating channel underlying our results relates to ATR in specific, and not to African magico-religious beliefs in general.

6.2. Traditional healers

Since the DHS only collects limited information on the use of traditional healthcare, we can only tentatively explore the influence of traditional healers on the demand for healthcare, relying on information on the type of person who assisted with the birth delivery, consultations and treatments for children who had a fever or diarrhea in the two weeks prior to the survey, and visits to biomedical health facilities in the past 12 months.

The results in Table 13 indicate that, all else equal, ATR mothers are significantly more likely to have a traditional birth attendant assist during the delivery of their child (2 percentage points), and are significantly more likely to consult a traditional healer to treat the diarrhea or fever of their child (2 percentage points). At the same time, ATR mothers are 5 percentage points less likely to have visited a biomedical health facility in the 12 months prior to the survey.[36] Finally, in

[35] This finding may relate to self-selection: when a child dies young, a witch may be blamed for its death. The belief in witchcraft may especially be high for mothers who have lost more than one child. On the other hand, it could relate to a belief in 'witch babies' whose presence may be detected at birth. Sargent (1988, 1981), doing research among the Bariba in Benin, notes that unusual features of either the infant or the birth process (e.g. birth occurring at eight months or babies born with teeth) are signs indicating the possible presence of a witch baby. Babies displaying such signs at birth or during teething were customarily killed or abandoned (Sargent, 1988: p.80).

[36] Besides the inclusion of our battery of controls, we use additional information from the DHS survey to rule out that this lower use reflects restricted access rather than lower demand of Voodoo mothers for health services offered by biomedical health facilities. The DHS records information on the potential hurdles to visiting a biomedical health facility. These include: not knowing where to go; getting permission; finding money to pay for the treatment; the distance to the health center; having to take transport; not wanting to go alone and the fear that there may not be a female health worker. For each of these potential hurdles, mothers indicate whether they present 'no problem', 'a small problem' or 'a big problem'. In Table A.14 (in the supplementary appendix) we present the marginal effects of mothers' ATR adherence calculated after Ordered Probit regressions on the determinants of each hurdle. Controlling for the full

columns 4-5 of Table 13 we look at the determinants of using ORS to treat diarrhea and using conventional medication (which includes aspirin, ibuprofen, paracetamol and several anti-malarial medications) to treat fever, for the subsample of children who suffered from these conditions in the two weeks prior to the survey. $Visit\_healer_{mhv}$ is a dummy indicating if a mother visited a traditional healer in order to treat the diarrhea or fever of her child(ren). We find that mothers who visited a traditional healer are 8 percentage points less likely to have used ORS to treat the diarrhea of their children, and 18 percentage points less likely to have used conventional medication to treat their children's fever.

In sum, ATR mothers are more likely to visit traditional healers and less likely to visit health centers. Mothers who visit a traditional healer are less likely to use ORS and other conventional medication to treat their children's illness. Given that we carefully accounted for access issues (cf. Table A.14 in the supplementary Appendix), these results suggest that the demand for conventional healthcare is lower for ATR mothers. Why their demand is lower, is a question that we cannot answer with the data at hand. One possibility is that traditional healers offer services and products that function as substitutes for conventional medicine (and that ATR-mothers are more exposed to these healers because traditional religious leaders often also function as healers). Alternatively, it could be that the ATR-affiliation makes mothers more susceptible to the influence and authority of traditional healers, which in turn may affect their heuristics about the usefulness of conventional health care. We can neither exclude that there is something about the ATR worldview, distinct from African cosmology in general (as discussed in the previous section), that leads both to an increased use of traditional healers and a reduced reliance on conventional medicine.

set of covariates and including cluster-level fixed effects, we find that ATR mothers consistently report having less problems with each of these potential obstacles.

7. Discussion

One of the stylized facts in the recent literature on health behavior in developing countries is that households tend to underinvest in preventive healthcare measures (Banerjee and Duflo, 2009; Dupas, 2011). The lower-than-optimal uptake is explained among others by liquidity constraints, time-inconsistent preferences and a lack of verifiable information on the cost-effectiveness of the measures (Dupas, 2011). Lacking such information, caretakers turn to heuristic decision-making, looking for rules of thumb, opinions of others, behavior of neighbors or their own understanding of sickness and health. Based on a large ethnographic literature, we conjectured that ATR may be an important input for such heuristic decision-making, either because of the authority of religious leaders, or because of its distinct worldview.

Our case study, Benin, is typical for a SSA country as ATR-related beliefs and practices are widespread. On the other hand, Benin is atypical as people freely report ATR adherence. The revealed ATR belief and its substantial within-village and within-household variation allowed us to estimate its impact on the uptake of several DHS healthcare measures and outcomes, while controlling for a large set of confounding factors. We find that, ceteris paribus, children whose mother is an ATR adherent are 3 percentage points more likely not to have received any vaccination, 3 percentage points less likely to be fully immunized, 6 percentage points less likely to live in a household which owns a bed net and 6 percentage points less likely to sleep under a bed net. Overall, these estimated ATR effects are larger than the effect of an additional six years of schooling for the mother or a change from the first to the second household wealth quintile. Even when comparing households with similar socio-economic characteristics, who live in the same survey cluster *and who own a bed net*, we find that children of an ATR mother are 3 percentage points less likely to sleep under the bed net. Mothers' ATR adherence is further associated with a

6 percentage point increase in their children's likelihood of testing positive for malaria and an under-five mortality rate which is higher with 9 deaths per 1,000 live births. We also find that the ATR effect is driven by the mother, who is the primary child care taker in Benin. The fact that father's ATR adherence is not important for the uptake of preventive healthcare measures or child health outcomes further increases confidence that our results are not driven by unobserved household factors that are related to ATR and influence the demand for preventive healthcare or child health outcomes.

Nevertheless, the ATR-health relationship may be spurious, as mothers could self-select into ATR. To formally investigate to what extent the results are driven by selection on unobservable variables, we turn to the procedures developed by Altonji et al. (2005) and fine-tuned by Oster (2016). In addition, we turn to an instrumental variables approach in which we take advantage of the fact that present-day ATR-adherence is not merely an individual choice, but is shaped by history and tradition. The combined results suggest that self-selection does not entirely drive our results. Even if the ATR-health relationship is partly spurious, our results are important from a policy perspective as they establish a highly robust correlation. This suggests that the uptake of preventive healthcare, and ultimately child health outcomes, may be improved by targeting ATR mothers.

We test for two main channels through which ATR may influence heuristic decision-making about healthcare measures: the ATR worldview and the reliance on traditional religious leaders. The analysis suggests that the mediating channel underlying our results relates to ATR in specific, and not to magico-religious beliefs in general. We find that ATR-mothers rely more on the services of traditional healers, but – due to issues of self-selection – this result does not allow us to draw strong conclusions on the role of traditional healers e.g. in providing substitutes for conventional medicine, or actively exercising influence in another way.

Millennium Development Goal 4 called for a two-thirds reduction in child mortality between 1990 and 2015. This goal has not been attained, but progress has been made: under-five mortality rate has dropped from 90 to 43 deaths per 1000 live births, globally, and from 179 to 86 deaths in SSA (UN, 2015). In order to achieve further declines, finding ways to improve the uptake of (preventive) healthcare is of critical importance. Our results suggest that properly acknowledging the role of ATR beliefs can help in bridging the last mile. Although the data at hand did not allow us to fully uncover the role of traditional healers, it is possible that they provide ATR-mothers with off-the-shelve answers on what (not) to do in terms of healthcare. This does not mean that the caretakers' minds are immune to new information. It does mean that it will take more than just information to persuade them. Acknowledging this means directing efforts at building trust in conventional healthcare providers and the health system, and working closely with traditional healers to persuade people.

Building partnerships between public health providers and traditional healers is easier said than done. A pilot-program doing exactly that was initiated in the South-West of Benin in 2009. Run by the Université Libre de Bruxelles and financed by the European Union, '*Interface entre prestataires de soins modernes et traditionnels*', created a platform where modern and traditional health providers could interact and exchange information; traditional healers also received medical training allowing them to quickly recognize severe cases of illness that needed referral to health centers. The project's evaluation report mentions that, as a result, referrals from traditional healers to health centers increased (Aissan et al., 2013). But, it also mentions that the referral system reduced the perceived contributions made by the traditional healer, thereby demotivating traditional healers to continue their collaboration with health centers. This account resonates the one made by French colonial administrators in 1906, who explained the opposition of Voodoo priests against smallpox vaccinations as resulting from a conflict of interest: "their benefits are reduced when they

have few patients to treat, smallpox being their assured commission money" (as cited in Soumonni, 2012). In combination with our results, these accounts suggest that any collaboration with traditional healers should be cleverly designed, duly taking into account the incentives on the part of traditional healers.

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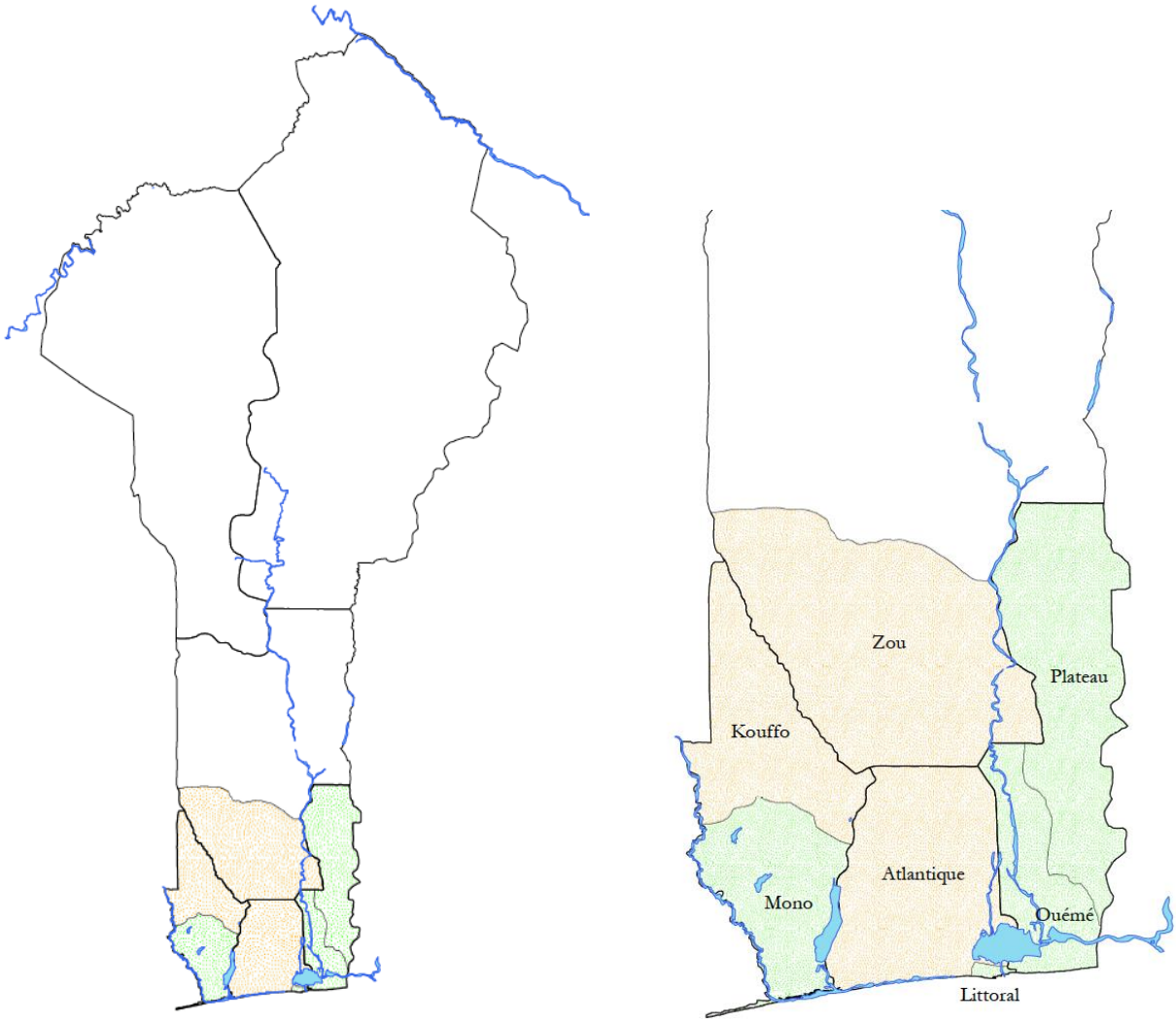
Figures

Figure 1: Southern Benin, and the approximate boundaries of the ancient Dahomey kingdom



Notes: The map indicates the seven departments of Southern Benin (Atlantique, Kouffo, Littoral, Mono, Ouémé, Plateau and Zou). The ancient Dahomey kingdom was located in the South-West of Benin. Historical maps from Dupuis (1998) indicate that the boundaries of the ancient Dahomey kingdom roughly corresponded to the present-day departments Atlantique, Kouffo and Zou (indicated in orange).

Tables

Table 1: Religious heterogeneity in our sample

	mothers' religious affiliation	*share of couples that are discordant*
Catholic	25.7%	38.6%
Islam	23.9%	18.2%
Traditional religion	18.7%	44.7%
Protestant	5.5%	62.8%
Other Christian religions	17.9%	45.3%
Other religions	1.5%	87.8%
No religion	6.9%	86.0%
Observations	23,801	6,533

Notes: The shares in the second column are based on the 6,533 households for which we have information on both parents. They are calculated using the following formula : $\frac{nr.of\ HH\ in\ which\ only\ one\ parent\ has\ religion\ X}{nr.of\ HH\ in\ which\ at\ least\ one\ parent\ has\ religion\ X}$ *with X taking on the different religions as reported in the DHS survey.*

Table 2: ATR-adherence by historical relationships

Panel A: Adja ethnicity

	Adja			obs.
	No	Yes		
ATR-adherence among mothers	13%	47%	***	23,801
ATR-adherence among fathers	18%	57%	***	6,533

Panel B: ancient Dahomey kingdom

	Dahomey			obs.
	No	Yes		
ATR-adherence among Adja mothers	35%	58%	***	3,888
ATR-adherence among other mothers	10%	22%	***	19,792
ATR-adherence among Adja fathers	47%	65%	***	1,047
ATR-adherence among other fathers	13%	31%	***	5,421

*Notes: *** p<0.01, ** p<0.05, * p<0.1; In Panel A we compare the ATR-adherence of Adja mothers and fathers with parents who belong to another ethnic group. In Panel B, we compare the ATR-adherence of mothers and fathers living within the boundaries of the ancient Dahomey kingdom with parents living outside those boundaries.*

Table 3: Healthcare in Benin

Panel A: Immunization rates, by DHS survey year

	none	full	bcg	dpt1	dpt2	dpt3	polio1	polio2	polio3	measles
1996	15.81%	45.55%	83.00%	79.55%	73.47%	64.13%	78.85%	71.94%	60.67%	54.59%
2001	8.18%	51.98%	88.68%	85.50%	78.32%	69.10%	88.41%	80.94%	65.79%	64.35%
2006	8.55%	43.54%	86.40%	82.46%	75.94%	66.67%	86.74%	79.34%	61.79%	61.43%
2012	12.65%	36.60%	85.95%	74.56%	71.05%	63.71%	82.54%	77.13%	52.32%	67.21%
Total	10.57%	42.24%	86.29%	79.70%	74.25%	65.71%	84.82%	78.19%	58.70%	63.50%

Notes: Column 1 represents the share of children who are at least one year old and have received none of the eight vaccinations required by WHO. The full immunization rates in column 2 represent the share of children who are at least one year old and have received all eight required vaccines: bcg, dpt1-3, polio 1-3 and measles.

Panel B: Bed nets

B.1 Ownership and use of bed nets, by DHS survey year

	own bed net	use bed net (some)	use bed net (all)
1996	n.a.	n.a.	n.a.
2001	44.0%	38.3%	35.3%
2006	63.4%	53.6%	47.0%
2012	89.8%	81.8%	74.2%

B.2 Characteristics of the bed nets used the night before the interview

	share of children who slept under a treated net	share of nets obtained from a distribution campaign	nr. of people who slept under the net
2006	30.15%	n.a.	2.98
2012	89.20%	74%	2.85

Notes: In the 1996 DHS round, information on the use of bed nets was not collected. The first column of Panel B.1 indicates the share of households which owns a bed net. The second (third) column indicates the share of households in which at least some (all) kids slept under a bed net the night before the interview.

Panel C: Mortality rates

	neonatal	infant	under five
1996	39	99	166
2001	39	91	151
2006	33	69	120
2012	24	43	67

Notes: The mortality rates are calculated following the procedures detailed in the 2012 Guide to DHS statistics. They are calculated for the five years preceding the survey-year and represent the number of deaths per 1,000 live births. The rates are calculated using the subsample of children for which complete information on the mother's demographic information is available. The neonatal-, infant- and under five-mortality rates represent, respectively, the probability of dying within the first month of life, before the first birthday, between birth and the fifth birthday.

Table 4: Preventive healthcare and child health outcomes by mothers' ATR adherence

Mother is an ATR adherent?	Yes	No	
Full immunization rate	36.7%	43.5%	***
Share of children that did not receive any of the eight required vaccinations	14.7%	9.6%	***
Share of households that own a bed net	56.0%	74.4%	***
Share of bed net-owning households in which all children slept under a bed net the night preceding the interview	73.4%	79.8%	***
Share of children that tested positive for malaria	39.5%	23.3%	***
Neonatal mortality rate	32.2	30.8	***
Infant mortality rate	69.3	64.6	***
Under-five mortality rate	116.3	108.0	***

*Notes: *** p<0.01, ** p<0.05, * p<0.1; The mortality rates are calculated for the five years preceding the survey-year and represent the number of deaths per 1,000 live births.*

Table 5: Relevant characteristics, by parents' ATR adherence

Mother is an ATR adherent?	*Yes*	*No*	
Household wealth (wealth quintile)	2.33	3.01	***
Share of households living in a rural area	81%	62%	***
Share of mothers living in a polygamous household	51%	38%	***
Number of children under five	1.79	1.71	***
Mother's age at first birth	19.11	19.58	***

Mother / father is an ATR adherent?		*Yes*	*No*	
Schooling				
	Years of schooling mother	0.43	1.57	***
	Years of schooling father	1.55	3.00	***
Age				
	Age mother	29.90	29.20	***
	Age father	39.37	36.63	***

*Notes: *** p<0.01, ** p<0.05, * p<0.1; A wealth index was calculated at the household-level as the first principal component of a large number of household assets including: source of water, type of toilet facility, type of floor/wall/roof-material, and the ownership of radio, television, telephone, refrigerator, car. From the index we calculated wealth quintiles which range from 1 to 5 with a mean value of 2.8 and a standard deviation of 1.36.*

Table 6: Determinants of not being vaccinated, for children aged 1-5

	(1)	(2)	(3)	(4)	(5)
mother is an ATR adherent	0.078***	0.036***	0.032***	0.033***	0.032***
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
Wealth quintile:					
2			-0.024***	-0.019**	-0.022***
			(0.008)	(0.008)	(0.008)
3			-0.045***	-0.036***	-0.041***
			(0.008)	(0.008)	(0.008)
4			-0.056***	-0.049***	-0.050***
			(0.009)	(0.009)	(0.009)
5			-0.077***	-0.069***	-0.067***
			(0.010)	(0.010)	(0.010)
age of mother				0.000	0.000
				(0.000)	(0.001)
mother's age at first birth				0.001**	0.001*
				(0.001)	(0.001)
years of schooling mother				-0.003***	-0.003***
				(0.001)	(0.001)
polygamous household				0.002	0.001
				(0.005)	(0.005)
gender of child (girl=1)					-0.004
					(0.004)
age of child (in months)					0.001***
					(0.000)
nr. of children < 5 in HH					0.004
					(0.003)
ethnicity of mother	No	No	No	Yes	Yes
birth order	No	No	No	No	Yes
DHS survey year	Yes	Yes	Yes	Yes	Yes
geographical department	Yes	No	No	No	No
cluster fixed effects	No	Yes	Yes	Yes	Yes
Observations	26,359	26,359	26,359	26,359	26,359
R2	0.03	0.26	0.26	0.27	0.27
Adjusted R2	0.03	0.21	0.21	0.21	0.22

*Notes: *** p<0.01, ** p<0.05, * p<0.1; Robust standard errors are clustered at the household-level and reported in parentheses; All specifications are estimated with a Linear Probability Model and include all children aged 1-5; The dependent variable is a dummy which takes the value one if a child did not receive any of the eight vaccinations recommended by the WHO.*

Table 7: Determinants of preventive healthcare measures and health outcomes

	Preventive healthcare measures				*Health outcomes*	
	no vaccines	full immunization	own bed net	use bed net	malaria positive	under 5 mortality
	(1)	(2)	(3)	(4)	(5)	(6)
mother is an ATR adherent	0.032***	-0.028***	-0.062***	-0.064***	0.056*	9.122**
	(0.007)	(0.010)	(0.010)	(0.012)	(0.031)	(4.182)
Wealth quintile:						
2	-0.022***	0.016	0.054***	0.047***	0.043	5.755
	(0.008)	(0.010)	(0.010)	(0.011)	(0.034)	(4.181)
3	-0.041***	0.052***	0.114***	0.098***	0.037	3.453
	(0.008)	(0.011)	(0.011)	(0.013)	(0.040)	(4.528)
4	-0.050***	0.072***	0.180***	0.143***	-0.057	-13.673***
	(0.009)	(0.013)	(0.013)	(0.015)	(0.042)	(4.966)
5	-0.067***	0.110***	0.277***	0.233***	-0.057	-28.541***
	(0.010)	(0.019)	(0.017)	(0.019)	(0.050)	(6.694)
age of mother	0.000	0.001	-0.002***	-0.002**	-0.000	0.651***
	(0.001)	(0.001)	(0.000)	(0.001)	(0.003)	(0.223)
mother's age at first birth	0.001*	0.000	0.002***	0.001	-0.005	-2.275***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.004)	(0.358)
years of schooling mother	-0.003***	0.009***	0.008***	0.008***	-0.001	-0.978**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.003)	(0.483)
polygamous household	0.001	-0.000	-0.008	-0.030***	0.009	28.736***
	(0.005)	(0.007)	(0.007)	(0.008)	(0.022)	(2.828)
gender of child (girl=1)	-0.004	-0.001		0.006	-0.014	
	(0.004)	(0.006)		(0.005)	(0.018)	
age of child (in months)	0.001***	0.003***		-0.002***	0.003***	
	(0.000)	(0.000)		(0.000)	(0.001)	
nr. of children < 5 in HH	0.004	-0.010***	0.021***	-0.010**	0.013	-38.148***
	(0.003)	(0.003)	(0.004)	(0.004)	(0.014)	(1.721)
household owns a bed net					-0.051	
					(0.046)	
child slept under bed net night before interview					-0.015	
					(0.030)	
ethnicity of mother	Yes	Yes	Yes	Yes	Yes	Yes
birth order	Yes	Yes	No	Yes	Yes	No
DHS survey year	Yes	Yes	Yes	Yes	Yes	Yes
cluster fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	26,359	26,359	20,327	25,038	2,757	22,821
R2	0.27	0.24	0.41	0.31	0.43	0.16
Adjusted R2	0.22	0.18	0.36	0.27	0.24	0.08

*Notes: *** p<0.01, ** p<0.05, * p<0.1; Robust standard errors are clustered at the household-level and reported in parentheses; No Vaccines, full immunization, own bed net, use bed net and malaria positive are dummy variables which take the value one if, respectively: a child did not receive a single vaccination, a child is fully immunized, a household owns a bed net, a child slept under a bed net the night preceding the interview, a child tested positive for malaria; The ownership of bed nets and the under-five mortality rate are estimated at the level of the mother. The determinants of immunization rates are estimated for all children aged 1-5, while the determinants of bed net use and a positive malaria test are estimated for all children aged 0-5 for which data was available; Information on bed nets was not collected in DHS 1996, the malaria test was only administered in DHS 2012; All specifications are estimated using a Linear Probability Model; This Table summarizes the most inclusive model specifications for each dependent variable - a full set of model specifications is available in the online appendix (Tables A.2 – A.6).*

Table 8: Subsample analysis: bed net owners and father's characteristics

Subsample:	**Bed net owners**	**Households with information on father's characteristics**					
		Preventive healthcare measures				*Health outcomes*	
	use bed net if own	no vaccination	full immunization	ownership bed net	use bed net	malaria positive	under 5 mortality
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
mother is an ATR adherent	-0.029***	0.116***	-0.080**	-0.113***	-0.110**	0.020	55.198***
	(0.011)	(0.032)	(0.039)	(0.040)	(0.051)	(0.085)	(17.883)
father is an ATR adherent	/	0.018	0.001	-0.047*	-0.069*	-0.034	16.923
	/	(0.018)	(0.031)	(0.027)	(0.035)	(0.053)	(11.555)
both parents are ATR adherents	/	0.048***	-0.033	-0.069***	-0.066**	0.042	18.895*
	/	(0.017)	(0.027)	(0.027)	(0.030)	(0.048)	(10.966)
age of mother	-0.001	-0.000	0.002	-0.005***	-0.003	-0.001	1.178*
	(0.001)	(0.002)	(0.002)	(0.001)	(0.002)	(0.004)	(0.675)
age of father	/	0.001	-0.001	-0.000	-0.000	0.001	-0.967*
	/	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.494)
mother's age at first birth	0.001	0.003	-0.000	0.003	0.001	-0.006	-2.485***
	(0.001)	(0.002)	(0.003)	(0.002)	(0.003)	(0.004)	(0.866)
years of schooling mother	0.002**	-0.001	0.006*	0.005*	0.002	-0.003	0.559
	(0.001)	(0.002)	(0.004)	(0.003)	(0.003)	(0.005)	(1.409)
years of schooling father	/	-0.002	0.006**	0.010***	0.008***	-0.001	-1.877*
	/	(0.002)	(0.003)	(0.002)	(0.002)	(0.004)	(0.961)
polygamous household	-0.037***	-0.008	0.019	0.015	-0.002	0.023	43.981***
	(0.007)	(0.012)	(0.017)	(0.017)	(0.019)	(0.030)	(7.020)
gender of child (girl=1)	0.009*	0.003	-0.016		-0.003	-0.038*	
	(0.005)	(0.008)	(0.013)		(0.011)	(0.023)	
age of child (in months)	-0.002***	0.001**	0.004***		-0.001***	0.003***	
	(0.000)	(0.000)	(0.000)		(0.000)	(0.001)	
nr. of children < 5 in HH	-0.027***	0.006	-0.004	0.018**	-0.035***	0.012	-35.939***
	(0.004)	(0.006)	(0.008)	(0.009)	(0.009)	(0.018)	(3.888)
ethnicity of mother	Yes	Yes	Yes	Yes	Yes	Yes	Yes
ethnicity of father	No	Yes	Yes	Yes	Yes	Yes	Yes
birth order	Yes	Yes	Yes	No	Yes	Yes	No
wealth quintiles	Yes	Yes	Yes	Yes	Yes	Yes	Yes
DHS survey year	Yes	Yes	Yes	Yes	Yes	Yes	Yes
cluster fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	19,436	6,826	6,826	5,138	6,266	2,032	5,809
R2	0.21	0.49	0.43	0.60	0.52	0.49	0.33
Adjusted R2	0.14	0.32	0.25	0.42	0.37	0.26	0.05

*Notes: *** p<0.01, ** p<0.05, * p<0.1; Robust standard errors are clustered at the household-level and reported in parentheses; The model specifications are based on those presented in Table 7; In the first column we restrict the sample to bed net-owning households. In columns 2-7, we restrict the sample to households with information on both parents and additionally control for father's characteristics; All specifications are estimated using a Linear Probability Model; Parent's ATR adherence is a categorical variable indicating if only the mother, only the father or both parents are ATR adherents - 'no ATR parents' is the reference category.*

Table 9: IV – instrumenting mother's ATR-adherence using 2SLS

	1st stage	2nd stage						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Mother's ATR-adherence	no vaccines	full immunization	own bed net	use bed net	use bed net if own	malaria positive	under 5 mortality
Panel A: Full sample								
mother is an ATR-adherent		0.143**	-0.153**	-0.103	-0.111*	-0.183***	0.472***	17.296
		(0.056)	(0.071)	(0.083)	(0.067)	(0.056)	(0.100)	(20.312)
Adja Dahomey	0.358***							
	(0.032)							
Observations	15,741	15,741	15,741	11,394	12,859	11,737	3,079	13,770
First stage F-test	152***							
Panel B: sample restricted to the South of Benin								
mother is an ATR-adherent		0.147***	-0.139*	-0.105	-0.117*	-0.198***	0.504***	16.817
		(0.057)	(0.074)	(0.090)	(0.068)	(0.056)	(0.104)	(20.591)
Adja Dahomey	0.351***							
	(0.032)							
Observations	9,528	9,528	9,528	6,979	8,036	7,342	1,992	8,252
First stage F-test	123***							
all baseline controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
dummy indicating rural area	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
dummy indicating south	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
cluster longitude	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
cluster latitude	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
cluster distance to closest city	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

*Notes: *** p<0.01, ** p<0.05, * p<0.1; Robust standard errors are clustered at the cluster-level and reported in parentheses; We instrument a mother's ATR-adherence with a dummy indicating if the mother belongs to the Adja ethnicity and currently lives within the boundaries of the ancient Dahomey kingdom; Columns 2-8 present second-stage results; The first-stage output presented in Column 1 is associated with the second-stage results presented in Column 2 – the first-stage results for the other outcome variables are comparable and omitted from the Table; All specifications are estimated using 2SLS.*

Table 10: Belief that AIDS can be caused by witchcraft

Panel A: Share of mothers who believe HIV can be caused by witchcraft

DHS survey	Overall	Voodoo	Not Voodoo	
2006	51.0	55.5	49.9	***
2012	43.7	47.7	42.9	***
Overall	47.5	52.2	46.5	***

Panel B: Share of belief in AIDS through witchcraft, by religious affiliation

Traditional religion	52.2
Catholic	46.2
Protestant	44.7
Other Christian religions	56.3
Islam	38.4
Other religions	50.4
No religion	44.1

*Notes: *** p<0.01, ** p<0.05, * p<0.1; This question was only asked in the 2006 and 2012 DHS surveys*

Table 11: Including mother's adherence to "other Christian religions" as the variable of interest

	no vaccination	full vaccination	ownership bed net	use bed net	malaria positive	under 5 mortality
	(1)	(2)	(3)	(4)	(5)	(6)
mother adheres to "another Christian religion"	-0.005	-0.008	0.018**	0.008	0.013	4.355
	(0.005)	(0.009)	(0.008)	(0.010)	(0.028)	(3.737)
all baseline controls	Yes	Yes	Yes	Yes	Yes	Yes
DHS survey year	Yes	Yes	Yes	Yes	Yes	Yes
cluster fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	26,359	26,359	20,327	25,038	2,757	22,821
R2	0.27	0.24	0.41	0.31	0.43	0.16
Adjusted R2	0.21	0.18	0.36	0.26	0.24	0.08

*Notes: *** p<0.01, ** p<0.05, * p<0.1; Robust standard errors are clustered at the household-level and reported in parentheses; The explanatory variable of interest is a dummy variable which takes the value one if a mother reports to adhere to "other Christian religions" (which includes Evangelicalism and Pentecostalism as well as African Independent Churches such as the Celestial Church); All specifications are estimated using a Linear Probability Model; Table A.11 in the supplementary appendix shows the coefficients for the baseline controls.*

Table 12: Including mother's belief that AIDS can be caused by witchcraft

	no vaccination		full vaccination		ownership bed net		use bed net		malaria positive		under 5 mortality	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
mother is an ATR adherent	0.023**	0.024**	-0.019	-0.019	-0.063***	-0.063***	-0.067***	-0.067***	0.054	0.049	7.407	7.013
	(0.009)	(0.010)	(0.014)	(0.014)	(0.013)	(0.013)	(0.015)	(0.015)	(0.038)	(0.038)	(5.739)	(5.738)
mother beliefs AIDS can be caused by witchcraft		-0.007		0.002		-0.010		-0.002		0.045		11.859***
		(0.006)		(0.010)		(0.008)		(0.009)		(0.031)		(3.806)
all baseline controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
DHS survey year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
cluster fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	14,472	14,472	14,472	14,472	11,958	11,958	16,312	16,312	1,976	1,976	11,958	11,958
R2	0.27	0.26	0.24	0.24	0.37	0.37	0.32	0.32	0.49	0.49	0.18	0.18
Adjusted R2	0.19	0.18	0.16	0.16	0.28	0.28	0.26	0.26	0.27	0.27	0.07	0.07

*Notes: *** p<0.01, ** p<0.05, * p<0.1; Robust standard errors are clustered at the household-level and reported in parentheses; Information on the relationship between witchcraft and AIDS was only asked in the 2006 and 2012 DHS survey rounds; We compare estimates that (do not) control for mother's reported belief that AIDS can be caused by witchcraft; To allow for a meaningful comparison, we restrict the sample to the observations for which information on this belief is available; All specifications are estimated using a Linear Probability Model; Table A.12 in the supplementary appendix shows the coefficients for the baseline controls.*

Table 13: Healthcare services chosen by ATR mothers

	visit health facility	traditional birth attendant	traditional healer to treat diarrhea or fever	use of ORS to treat diarrhea	use of medication to treat fever
	(1)	(2)	(3)	(4)	(5)
mother is an ATR adherent	-0.047***	0.020***	0.017***	0.000	-0.081***
	(0.010)	(0.005)	(0.006)	(0.031)	(0.021)
visited a traditional healer				-0.082**	-0.176***
				(0.040)	(0.046)
all baseline controls	Yes	Yes	Yes	Yes	Yes
DHS survey year	Yes	Yes	Yes	Yes	Yes
cluster fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	35,106	34,984	10,318	3,262	6,430
R2	0.29	0.28	0.26	0.53	0.42
Adjusted R2	0.24	0.23	0.10	0.24	0.26

*Notes: *** p<0.01, ** p<0.05, * p<0.1; The dependent variables are dummy variables which take the value one if, respectively: (1) a mother visited a health facility in the 12 months prior to the interview; (2) a traditional birth attendant assisted with the delivery of the child; (3) a mother visited a traditional healer to treat the diarrhea or fever of her child in the two weeks prior to the interview; (4) a mother used ORS to treat her child's diarrhea; (5) a mother used conventional medication (which includes aspirin, ibuprofen, paracetamol and several anti-malarial medications) to treat her child's fever. In columns 3-5 the sample is restricted to mothers whose child had diarrhea or fever in the two weeks prior the interview; Robust standard errors are clustered at the household-level and reported in parentheses; Table A.13 in the supplementary appendix shows the coefficients for the baseline controls.*

Supplementary appendix

Table A.1: Summary statistics

Observations by DHS survey year	obs.	%
1996	2,833	8.07%
2001	5,067	14.43%
2006	14,645	41.70%
2012	12,576	35.81%
Total	35,121	100%

Household demographics	mean	st.dev.	min.	max.	obs.
age mother	29.3	6.7	15	49	23,801
age father	37.3	9.1	17	64	6,533
years of schooling mother	1.36	2.9	0	21	23,801
years of schooling father	3.0	4.4	0	21	6,533
mother's age at first birth	19.5	3.8	8	43	23,801
age of child (in months)	28.1	17.1	0	59	36,797
number of children < 5 in the household	1.7	1	0	9	23,801
child is a girl	49.3%	0.5	0	1	36,797
household lives in rural area	65.7%	0.47	0	1	23,801
polygamous household	40.4%	0.49	0	1	23,801

Ethnicity of parents	mother	father
Adja	16.4%	16.2%
Bariba	9.7%	10.7%
Betamaribe	7.6%	7.4%
Dendi	3.4%	3.6%
Fon	41.0%	41.2%
Peulh	5.5%	5.9%
Yoa & Lokpa	4.6%	4.9%
Yoruba	10.1%	9.2%
Other	1.7%	1.1%

Notes: This Table includes observations for whom we have complete information on mother's demographic characteristics. The full sample comprises 35,121 children aged 0-5, living in 23,801 households. Information on fathers' characteristics is available for a sub-sample of 6,533 households.

Table A.2: Determinants of full immunization among children aged 1-5

	(1)	(2)	(3)	(4)	(5)
mother is an ATR adherent	-0.095***	-0.035***	-0.029***	-0.028***	-0.028***
	(0.009)	(0.010)	(0.010)	(0.010)	(0.010)
Wealth quintile:					
2			0.020**	0.016	0.016
			(0.010)	(0.010)	(0.010)
3			0.062***	0.054***	0.052***
			(0.011)	(0.011)	(0.011)
4			0.086***	0.074***	0.072***
			(0.013)	(0.013)	(0.013)
5			0.143***	0.112***	0.110***
			(0.018)	(0.019)	(0.019)
age of mother				0.002***	0.001
				(0.001)	(0.001)
mother's age at first birth				-0.000	0.000
				(0.001)	(0.001)
years of schooling mother				0.009***	0.009***
				(0.001)	(0.001)
polygamous household				-0.006	-0.000
				(0.007)	(0.007)
gender of child (girl=1)					-0.001
					(0.006)
age of child (in months)					0.003***
					(0.000)
nr. of children < 5 in HH					-0.010***
					(0.003)
ethnicity of mother	No	No	No	Yes	Yes
birth order	No	No	No	No	Yes
DHS survey year	Yes	Yes	Yes	Yes	Yes
geographical department	Yes	No	No	No	No
cluster fixed effects	No	Yes	Yes	Yes	Yes
Observations	26,359	26,359	26,359	26,359	26,359
R2	0.02	0.22	0.22	0.22	0.24
Adjusted R2	0.02	0.16	0.16	0.16	0.18

*Notes: *** p<0.01, ** p<0.05, * p<0.1; Robust standard errors are clustered at the household-level and reported in parentheses; All specifications are estimated with a Linear Probability Model and include all children aged 1-5; The dependent variable is a dummy which takes the value one if a child is fully immunized (i.e. received all eight vaccinations recommended by the WHO).*

Table A.3: The ownership of bed nets within a household

	(1)	(2)	(3)	(4)	(5)
mother is an ATR adherent	-0.147***	-0.081***	-0.068***	-0.062***	-0.062***
	(0.009)	(0.010)	(0.010)	(0.010)	(0.010)
Wealth quintile:					
2			0.059***	0.055***	0.054***
			(0.010)	(0.010)	(0.010)
3			0.122***	0.114***	0.114***
			(0.011)	(0.011)	(0.011)
4			0.195***	0.182***	0.180***
			(0.013)	(0.013)	(0.013)
5			0.311***	0.278***	0.277***
			(0.017)	(0.017)	(0.017)
age of mother				-0.002***	-0.002***
				(0.000)	(0.000)
mother's age at first birth				0.002***	0.002***
				(0.001)	(0.001)
years of schooling mother				0.008***	0.008***
				(0.001)	(0.001)
polygamous household				0.002	-0.008
				(0.006)	(0.007)
nr. of children < 5 in HH					0.021***
					(0.004)
ethnicity of mother	No	No	No	Yes	Yes
DHS survey year	Yes	Yes	Yes	Yes	Yes
geographical department	Yes	No	No	No	No
cluster fixed effects	No	Yes	Yes	Yes	Yes
Observations	20,327	20,327	20,327	20,327	20,327
R2	0.16	0.39	0.40	0.41	0.41
Adjusted R2	0.16	0.33	0.35	0.36	0.36

*Notes: *** p<0.01, ** p<0.05, * p<0.1; Robust standard errors are clustered at the household-level and reported in parentheses; All specifications are estimated with a Linear Probability Model and include all the mothers in our sample; Information on bed nets was not collected in DHS 1996; The dependent variable is a dummy which takes the value one if the household owns a bed net.*

Table A.4: Determinants of sleeping under a bed net the night before the interview

	(1)	(2)	(3)	(4)	(5)
mother is an ATR adherent	-0.159***	-0.086***	-0.076***	-0.065***	-0.064***
	(0.011)	(0.012)	(0.012)	(0.012)	(0.012)
Wealth quintile:					
2			0.047***	0.047***	0.047***
			(0.012)	(0.011)	(0.011)
3			0.100***	0.097***	0.098***
			(0.013)	(0.013)	(0.013)
4			0.148***	0.141***	0.143***
			(0.015)	(0.015)	(0.015)
5			0.260***	0.232***	0.233***
			(0.019)	(0.019)	(0.019)
age of mother				-0.004***	-0.002**
				(0.001)	(0.001)
mother's age at first birth				0.002**	0.001
				(0.001)	(0.001)
years of schooling mother				0.008***	0.008***
				(0.001)	(0.001)
polygamous household				-0.035***	-0.030***
				(0.008)	(0.008)
gender of child (girl=1)					0.006
					(0.005)
age of child (in months)					-0.002***
					(0.000)
nr. of children < 5 in HH					-0.010**
					(0.004)
ethnicity of mother	No	No	No	Yes	Yes
birth order	No	No	No	No	Yes
DHS survey year	Yes	Yes	Yes	Yes	Yes
geographical department	Yes	No	No	No	No
cluster fixed effects	No	Yes	Yes	Yes	Yes
Observations	25,038	25,038	25,038	25,038	25,038
R2	0.09	0.30	0.30	0.31	0.31
Adjusted R2	0.08	0.25	0.26	0.26	0.27

*Notes: *** p<0.01, ** p<0.05, * p<0.1; Robust standard errors are clustered at the household-level and reported in parentheses; Information on bed nets was not collected in DHS 1996; All specifications are estimated with a Linear Probability Model and include all children aged 0-5; The dependent variable is a dummy which takes the value one if the child slept under a bed net the night preceding the interview.*

Table A.5: Determinants of a positive malaria test

	(1)	(2)	(3)	(4)	(5)	(6)
mother is an ATR adherent	0.188***	0.076**	0.071**	0.065*	0.061*	0.056*
	(0.030)	(0.031)	(0.031)	(0.035)	(0.031)	(0.031)
Wealth quintile:						
2			0.033	0.034	0.040	0.043
			(0.034)	(0.039)	(0.034)	(0.034)
3			0.033	0.033	0.037	0.037
			(0.040)	(0.045)	(0.040)	(0.040)
4			-0.056	-0.057	-0.058	-0.057
			(0.042)	(0.049)	(0.042)	(0.042)
5			-0.068	-0.065	-0.063	-0.057
			(0.049)	(0.058)	(0.050)	(0.050)
age of mother				0.001	0.000	-0.000
				(0.002)	(0.003)	(0.003)
mother's age at first birth				-0.005*	-0.005	-0.005
				(0.003)	(0.004)	(0.004)
years of schooling mother				-0.002	-0.001	-0.001
				(0.004)	(0.003)	(0.003)
polygamous household				0.015	0.010	0.009
				(0.024)	(0.022)	(0.022)
gender of child (girl=1)					-0.015	-0.014
					(0.018)	(0.018)
age of child (in months)					0.003***	0.003***
					(0.001)	(0.001)
nr. of children < 5 in HH					0.014	0.013
					(0.014)	(0.014)
HH owns a bed net						-0.051
						(0.046)
child slept under bed net night before interview						-0.015
						(0.030)
ethnicity of mother	No	No	No	Yes	Yes	Yes
birth order	No	No	No	No	Yes	Yes
geographical department	Yes	No	No	No	No	No
cluster fixed effects	No	Yes	Yes	Yes	Yes	Yes
Observations	2,757	2,757	2,757	2,757	2,757	2,757
R2	0.05	0.41	0.42	0.42	0.43	0.43
Adjusted R2	0.04	0.23	0.24	0.23	0.24	0.24

*Notes: *** p<0.01, ** p<0.05, * p<0.1; Robust standard errors are clustered at the household-level and reported in parentheses; Information on this test was only collected in DHS 2012; All specifications are estimated using a Linear Probability Model and include all children aged 0-5; The dependent variable is a dummy which takes the value one if the child tested positive for malaria.*

Table A.6: Determinants of the under-five mortality rate

	(1)	(2)	(3)	(4)
mother is an ATR adherent	20.639***	12.680***	9.224**	9.122**
	(3.617)	(4.252)	(4.265)	(4.182)
Wealth quintile:				
2			4.105	5.755
			(4.266)	(4.181)
3			3.522	3.453
			(4.626)	(4.528)
4			-16.805***	-13.673***
			(5.063)	(4.966)
5			-30.336***	-28.541***
			(6.813)	(6.694)
age of mother			1.112***	0.651***
			(0.222)	(0.223)
mother's age at first birth			-2.325***	-2.275***
			(0.365)	(0.358)
years of schooling mother			-0.625	-0.978**
			(0.491)	(0.483)
polygamous household				28.736***
				(2.828)
nr. of children < 5 in HH				-38.148***
				(1.721)
ethnicity of mother	No	No	Yes	Yes
DHS survey year	Yes	Yes	Yes	Yes
geographical department	Yes	No	No	No
cluster fixed effects	No	Yes	Yes	Yes
Observations	22,821	22,821	22,821	22,821
R2	0.02	0.12	0.13	0.16
Adjusted R2	0.02	0.04	0.05	0.08

*Notes: *** p<0.01, ** p<0.05, * p<0.1; Robust standard errors are clustered at the household-level and reported in parentheses; All specifications are estimated with a Linear Probability Model and include all the mothers in our sample; The dependent variable is the under-five mortality rate calculated at the level of the mother.*

Table A.7: Determinants of preventive healthcare measures and health outcomes, clustering the standard errors at the level of the survey cluster

	Preventive healthcare measures				*Health outcomes*	
	no vaccines	full immunization	own bed net	use bed net	malaria positive	under 5 mortality
	(1)	(2)	(3)	(4)	(5)	(6)
mother is an ATR adherent	0.032***	-0.028**	-0.062***	-0.064***	0.056	9.122**
	(0.008)	(0.011)	(0.010)	(0.013)	(0.035)	(4.402)
Wealth quintile:						
2	-0.022**	0.016	0.054***	0.047***	0.043	5.755
	(0.009)	(0.011)	(0.011)	(0.013)	(0.038)	(4.442)
3	-0.041***	0.052***	0.114***	0.098***	0.037	3.453
	(0.009)	(0.012)	(0.012)	(0.015)	(0.045)	(4.754)
4	-0.050***	0.072***	0.180***	0.143***	-0.057	-13.673**
	(0.010)	(0.014)	(0.015)	(0.017)	(0.049)	(5.317)
5	-0.067***	0.110***	0.277***	0.233***	-0.057	-28.541***
	(0.011)	(0.020)	(0.021)	(0.023)	(0.057)	(7.282)
age of mother	0.000	0.001	-0.002***	-0.002**	-0.000	0.651***
	(0.001)	(0.001)	(0.000)	(0.001)	(0.003)	(0.236)
mother's age at first birth	0.001*	0.000	0.002***	0.001	-0.005	-2.275***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.004)	(0.385)
years of schooling mother	-0.003***	0.009***	0.008***	0.008***	-0.001	-0.978*
	(0.001)	(0.002)	(0.001)	(0.001)	(0.004)	(0.522)
polygamous household	0.001	-0.000	-0.008	-0.030***	0.009	28.736***
	(0.005)	(0.007)	(0.007)	(0.008)	(0.025)	(3.017)
gender of child (girl=1)	-0.004	-0.001		0.006	-0.014	
	(0.004)	(0.006)		(0.005)	(0.019)	
age of child (in months)	0.001***	0.003***		-0.002***	0.003***	
	(0.000)	(0.000)		(0.000)	(0.001)	
nr. of children < 5 in HH	0.004	-0.010**	0.021***	-0.010**	0.013	-38.148***
	(0.003)	(0.004)	(0.004)	(0.005)	(0.017)	(1.965)
Household owns a bed net					-0.051	
					(0.055)	
child slept under bed net night before interview					-0.015	
					(0.034)	
ethnicity of mother	Yes	Yes	Yes	Yes	Yes	Yes
birth order	Yes	Yes	No	Yes	Yes	No
DHS survey year	Yes	Yes	Yes	Yes	Yes	Yes
cluster fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	26,359	26,359	20,327	25,038	2,757	22,821
R2	0.27	0.24	0.41	0.31	0.43	0.16
Adjusted R2	0.22	0.18	0.36	0.27	0.24	0.08

*Notes: *** p<0.01, ** p<0.05, * p<0.1; Robust standard errors are clustered at the level of the survey cluster and reported in parentheses; No Vaccines, full immunization, own bed net, use bed net and malaria positive are dummy variables which take the value one if, respectively: a child did not receive a single vaccination, a child is fully immunized, a household owns a bed net, a child slept under a bed net the night preceding the interview, a child tested positive for malaria; The ownership of bed nets and the under-five mortality rate are estimated at the level of the mother. The determinants of immunization rates are estimated for all children aged 1-5, while the determinants of bed net use and a positive malaria test are estimated for all children aged 0-5 for which data was available; Information on bed nets was not collected in DHS 1996, the malaria test was only administered in DHS 2012; All specifications are estimated using a Linear Probability Model.*

Table A.8: Comparing the estimates of LPM and Logit models

	no vaccines		full immunization		own bed net		use bed net		malaria positive	
	LPM	Logit	LPM	Logit	LPM	Logit	LPM	Logit	LPM	Logit
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
mother is an ATR adherent	0.055***	0.087***	-0.028***	-0.027***	-0.078***	-0.078***	-0.065***	-0.067***	0.095**	0.098***
	(0.011)	(0.001)	(0.011)	(0.000)	(0.013)	(0.000)	(0.013)	(0.001)	(0.043)	(0.003)
age of mother	-0.000	0.000***	0.001	0.001***	-0.003***	-0.003***	-0.002**	-0.002***	-0.001	-0.001***
	(0.001)	(0.000)	(0.001)	(0.000)	(0.001)	(0.000)	(0.001)	(0.000)	(0.005)	(0.000)
mother's age at first birth	0.003*	0.003***	0.001	0.001***	0.003***	0.004***	0.002	0.002	-0.006	-0.007*
	(0.001)	(0.000)	(0.001)	(0.000)	(0.001)	(0.000)	(0.001)	(0.001)	(0.006)	(0.003)
years of schooling mother	-0.008***	-0.016***	0.009***	0.008***	0.012***	0.017***	0.009***	0.012***	-0.003	-0.002***
	(0.002)	(0.000)	(0.002)	(0.000)	(0.002)	(0.000)	(0.002)	(0.000)	(0.007)	(0.000)
polygamous household	0.001	0.006	-0.003	-0.001	-0.014*	-0.013	-0.034***	-0.038***	0.003	0.015
	(0.008)	(0.010)	(0.008)	(0.006)	(0.009)	(0.008)	(0.009)	(0.008)	(0.035)	(0.032)
gender of child (girl=1)	-0.008	-0.014***	0.001	0.001***			0.006	0.008***	-0.020	-0.019***
	(0.006)	(0.000)	(0.006)	(0.000)			(0.006)	(0.000)	(0.030)	(0.001)
age of child (in months)	0.001***	0.002***	0.004***	0.004***			-0.002***	-0.002***	0.004***	0.004***
	(0.000)	(0.000)	(0.000)	(0.000)			(0.000)	(0.000)	(0.001)	(0.000)
nr. of children < 5 in HH	0.004	0.005***	-0.008**	-0.008***	0.028***	0.031***	-0.007	-0.012***	0.020	0.021
	(0.004)	(0.000)	(0.004)	(0.000)	(0.005)	(0.000)	(0.005)	(0.004)	(0.021)	(0.018)
household owns a bed net									-0.055	-0.088
									(0.073)	(0.068)
child slept under bed net night before the interview									-0.018	-0.013
									(0.043)	(0.040)
wealth quintiles	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
ethnicity of mother	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
birth order	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes
DHS survey year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
cluster fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	14,293	14,293	25,235	25,235	15,205	15,205	22,145	22,145	1,621	1,621

*Notes: *** p<0.01, ** p<0.05, * p<0.1; Robust standard errors are clustered at the household-level and reported in parentheses; The LPM specifications are those reported in Table 7 of the paper, now restricting the sample to survey clusters which have variation in the dependent variable; The under-five mortality rate is not an indicator variable and is hence not included in this robustness check; The coefficients reported in columns with the header 'Logit' represent marginal effects. They were calculated following the procedure suggested by* Beck (2015)*: We first estimate the regression coefficients with a conditional logit model (clogit). Then we run a fixed effects logit model, constraining the coefficients to those estimated by clogit, from which we calculate the marginal effects.*

Table A.9: Estimated ATR-effects, by DHS survey year

		no vaccines	full immunization	own bed net	use bed net	malaria positive	under 5 mortality
		(1)	(2)	(3)	(4)	(5)	(6)
	ATR effect	0.017	-0.032*	-0.046***	-0.047***	0.069**	23.854***
2012		(0.014)	(0.018)	(0.013)	(0.018)	(0.030)	(6.923)
	obs.	*9,108*	*9,108*	*7,443*	*10,030*	*2,757*	*7,443*
	ATR effect	0.042***	-0.013	-0.071***	-0.063***		1.724
2006		(0.010)	(0.016)	(0.017)	(0.017)	*n.a.*	(6.668)
	obs.	*11,412*	*11,412*	*9,562*	*13,242*		*9,562*
	ATR effect	0.021	-0.041	-0.065***	-0.082*		5.407
2001		(0.015)	(0.026)	(0.023)	(0.046)	*n.a.*	(12.378)
	obs.	*3,815*	*3,815*	*3,322*	*1,766*		*3,327*
	ATR effect	0.046**	-0.043				9.346
1996		(0.023)	(0.033)	*n.a.*	*n.a.*	*n.a.*	(12.925)
	obs.	*2,024*	*2,024*				*2,489*

*Notes: *** p<0.01, ** p<0.05, * p<0.1; The Table presents the ATR-effects estimated in four sets of regressions, one for each available DHS survey year; The regressions control for the same set of covariates as reported in Table 7 of the paper; Robust standard errors are clustered at the household-level and reported in parentheses; Information on bed nets was not collected in DHS 1996, the malaria test was only administered in DHS 2012; All specifications are estimated using a Linear Probability Model.*

Table A.10: Using selection on observables to assess the bias from unobservable

	Baseline controls		Baseline controls + father's characteristics	
	δ	$\bar{R}_{max}$	δ	$\bar{R}_{max}$
Received not a single vaccination	5.25	0.35	12.01	0.64
Full immunization	2.08	0.31	9.44	0.56
Ownership of bed net	1.88	0.53	1.74	0.77
Use of bed net	2.06	0.42	1.03	0.68
Malaria positive	1.73	0.56	/	/
Under 5 mortality	2.40	0.21	8.99	0.52

Notes: δ is a measure that indicates how large selection on unobservables needs to be, relative to selection on observables, to fully explain away the estimated ATR-effects reported in Table 7 of the paper (for δ in column 2) and Table 8 of the paper (for δ in column 4). $\bar{R}_{max}$ is the R-squared from a hypothetical regression that controls for all observables and unobservables. As suggested by Oster (2016), we set $\bar{R}_{max} = 1.3\ R^c$. For the outcome "malaria positive" no values were reported in columns 4-5 because the estimated ATR-effect is not significant in the subsample with information on the characteristics of both parents.

Explanatory notes on the 'Oster method'

To assess the influence of unobservables, we turn to the approach proposed by Altonji et al. (2005) and fine-tuned by Oster (2016). The approach uses the selection on observable variables as a guide to assess the potential bias from unobserved variables. Put very simply: if adding a battery of *relevant* observables does not affect our coefficient of interest much, then it is unlikely that there exist many unobservables that would completely cancel out our result.

The selection on observable variables can be evaluated by looking at coefficient movements in the ATR-estimate while gradually adding additional control variables; their relevance is assessed by the associated movements in the R-squared. Based on these insights, Oster (2016) develops a measure that indicates how large selection on unobservable variables has to be, relative to selection on observables, to fully explain away the estimated effect.[37]

[37] The calculations can be performed with the Stata Code 'psacalc', provided by Oster (2016) and freely available through ssc.

The larger the measure, denoted by δ, the less likely the threat of omitted variable bias. To calculate δ, we first run two regressions for each outcome variable: an uncontrolled and a controlled regression. In the uncontrolled regression, we only regress the outcome variable on a mother's ATR adherence. In the controlled regression we control for the observed covariates discussed above. Denote the estimated coefficient on a mother's ATR adherence β^u in the uncontrolled regression and β^c in the controlled regression; R^u and R^c are the R-squared values associated with these regressions. Next, the procedure requires to make an assumption about R_{max}, which is defined as the R-squared from a hypothetical regression that controls for all observed *and* unobserved covariates. We follow Oster (2016) in setting $\bar{R}_{max} = 1.3\ R^c$.[38] δ is then calculated as follows: $\delta = \frac{\beta^c\ (R^c - R^u)}{(\beta^u - \beta^c)(\bar{R}_{max} - R^c)}$.[39] Oster (2016) argues that a value of δ > 1 (i.e. that selection on observables is at least as important as selection on unobservables) indicates a result that is robust to omitted variable bias.

We consider two sets of controlled regressions; the first includes all covariates discussed in section 4 of the paper, the second also includes fathers' characteristics (discussed in section 5.1 of the paper). The results in the first and third column of Table A.10 report the values of δ for both sets of controlled regressions. For every outcome variable we find that δ > 1. When the controlled regressions include only the baseline controls (column 1), we find that for most outcome variables, selection on unobserved covariates has to be about twice as important as selection on the included covariates to fully explain away the estimated ATR-

[38] Oster (2016) derives this value by analyzing coefficient movements for 65 randomized studies, published in five top economic journals between 2008-2013, that provide estimates with and without controls. With a value of $R_{max} = 1.3\ R^c$, 90% of the evaluated randomized results survived.

[39] Consider the intuition behind this expression. We find β^c in the numerator, indicating that the larger β^c, the larger the effect that needs to be explained away by selection on unobservables. In the denominator we find $(\beta^u - \beta^c)$: the smaller the difference between β^u and β^c, the less the ATR-estimate is affected by selection on observables, and the larger selection on unobservables needs to be, relative to selection on observables, to fully explain away the estimated ATR-effect. The strength of the observed covariates increases in $(R^c - R^u)$ and decreases in $(\bar{R}_{max} - R^c)$: the larger the difference between R^c and R^u, the more variation in the outcome variable is accounted for by observed covariates; on the other hand, the smaller the difference between $\bar{R}_{max}$ and R^c, the more of the 'explainable' variation is accounted for by the observed covariates.

effects (reported in Table 7 of the paper). When looking at the outcome 'received not a single vaccination', selection on unobserved covariates would need to be five times more important. The value of δ strongly increases for several outcome variables when the controlled regressions also include father's characteristics (column 3).

Specifically, we find that that selection on unobservables would need to be 12.0, 9.4 and 9.0 times as large as selection on observables to fully explain away the estimated ATR-effects (reported in Table 8 of the paper) on 'not having received a single vaccination', 'full immunization' and 'under 5 mortality'.[40]

[40] When following the procedures outlined in Oster (2016), the assumed values for R_{max} are rather low for the first set of controlled regressions (varying between 0.21 and 0.56). Both Oster (2016) and González and Miguel (2015) argue that R_{max} is bounded below one when there is measurement error in the dependent variable. Work by McKenzie (2012: p.214) further suggests that measurement errors may be substantial in the context of low income country household datasets; he demonstrates that *"for many economic outcomes, the autocorrelations are typically lower than 0.5, with many around 0.3" and that "autocorrelations are often in the 0.2-0.3 range for household income and consumption"*. In our case, the outcome variables with the lowest R_{max} – 'under-five mortality' (0.21), 'not being vaccinated' (0.35) and 'being fully immunized' (0.31) – are indeed most likely to suffer from substantial measurement error. The under-five mortality rate is a composite measure which depends on the correct measurement of several variables (e.g. number of children born, number of children still alive, exact date of birth of all children, age in months at death). Moreover, measurement error may be aggravated due to the sensitive nature of the questions. Outcomes pertaining to vaccination are also composite measures, relying on the correct measurement of (not) having received the eight recommended vaccines. On the other hand, the outcome variables that are relatively easier to measure – 'the ownership of bed nets', and 'testing positive for malaria' – yield higher values for R_{max} (0.53 and 0.56 respectively). Finally, all values of R_{max} increase substantially (varying between 0.52 and 0.77) when the controlled regressions additionally include father's characteristics.

Table A.11: Including mother's adherence to "other Christian religions" as the variable of interest

	no vaccination	full vaccination	ownership bed net	use bed net	malaria positive	under 5 mortality
	(1)	(2)	(3)	(4)	(5)	(6)
mother adheres to "another Christian religion"	-0.005	-0.008	0.018**	0.008	0.013	4.355
	(0.005)	(0.009)	(0.008)	(0.010)	(0.028)	(3.737)
Wealth quintile:						
2	-0.022***	0.017	0.055***	0.048***	0.044	5.640
	(0.008)	(0.010)	(0.010)	(0.011)	(0.034)	(4.181)
3	-0.042***	0.053***	0.116***	0.101***	0.036	3.036
	(0.008)	(0.011)	(0.011)	(0.013)	(0.040)	(4.525)
4	-0.052***	0.073***	0.183***	0.146***	-0.058	-14.256***
	(0.009)	(0.013)	(0.013)	(0.015)	(0.043)	(4.959)
5	-0.070***	0.112***	0.282***	0.238***	-0.066	-29.343***
	(0.010)	(0.019)	(0.017)	(0.019)	(0.050)	(6.691)
age of mother	0.000	0.001	-0.002***	-0.002**	0.000	0.680***
	(0.001)	(0.001)	(0.000)	(0.001)	(0.003)	(0.222)
mother's age at first birth	0.001*	0.000	0.002***	0.001	-0.005	-2.285***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.004)	(0.358)
years of schooling mother	-0.003***	0.009***	0.009***	0.008***	-0.001	-1.057**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.003)	(0.481)
polygamous household	0.002	-0.001	-0.010	-0.032***	0.013	28.959***
	(0.005)	(0.007)	(0.007)	(0.008)	(0.022)	(2.825)
gender of child (girl=1)	-0.004	-0.001		0.007	-0.014	
	(0.004)	(0.006)		(0.005)	(0.018)	
age of child (in months)	0.001***	0.003***		-0.002***	0.003***	
	(0.000)	(0.000)		(0.000)	(0.001)	
nr. of children < 5 in HH	0.004	-0.010***	0.021***	-0.010**	0.014	-38.134***
	(0.003)	(0.003)	(0.004)	(0.004)	(0.014)	(1.720)
ethnicity of mother	Yes	Yes	Yes	Yes	Yes	Yes
birth order	Yes	Yes	No	Yes	Yes	No
DHS survey year	Yes	Yes	Yes	Yes	Yes	Yes
cluster fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	26,359	26,359	20,327	25,038	2,757	22,821
R2	0.27	0.24	0.41	0.31	0.43	0.16
Adjusted R2	0.21	0.18	0.36	0.26	0.24	0.08

*Notes: *** p<0.01, ** p<0.05, * p<0.1; Robust standard errors are clustered at the household-level and reported in parentheses; The explanatory variable of interest is a dummy variable which takes the value one if a mother reports to adhere to "other Christian religions" (which includes Evangelicalism and Pentecostalism as well as African Independent Churches such as the Celestial Church); All specifications are estimated using a Linear Probability Model.*

Table A.12: Including mother's belief that AIDS can be caused by witchcraft

	no vaccination		full vaccination		ownership bed net		use bed net		malaria positive		under 5 mortality	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
mother is an ATR adherent	0.023**	0.024**	-0.019	-0.019	-0.063***	-0.063***	-0.067***	-0.067***	0.054	0.049	7.407	7.013
	(0.009)	(0.010)	(0.014)	(0.014)	(0.013)	(0.013)	(0.015)	(0.015)	(0.038)	(0.038)	(5.739)	(5.738)
mother beliefs AIDS can be caused by witchcraft		-0.007		0.002		-0.010		-0.002		0.045		11.859***
		(0.006)		(0.010)		(0.008)		(0.009)		(0.031)		(3.806)
Wealth quintile:												
2	-0.020*	-0.016	0.013	0.013	0.055***	0.056***	0.037***	0.038***	0.060	0.062	5.610	5.236
	(0.011)	(0.011)	(0.015)	(0.015)	(0.013)	(0.013)	(0.015)	(0.015)	(0.044)	(0.044)	(5.852)	(5.848)
3	-0.035***	-0.030**	0.029*	0.029*	0.114***	0.114***	0.086***	0.086***	0.054	0.056	4.836	4.843
	(0.011)	(0.012)	(0.016)	(0.016)	(0.014)	(0.014)	(0.016)	(0.016)	(0.049)	(0.048)	(6.361)	(6.361)
4	-0.034***	-0.034***	0.045**	0.045**	0.190***	0.190***	0.138***	0.138***	-0.054	-0.054	-13.412**	-13.353**
	(0.012)	(0.012)	(0.018)	(0.018)	(0.016)	(0.016)	(0.018)	(0.018)	(0.051)	(0.051)	(6.780)	(6.782)
5	-0.047***	-0.049***	0.076***	0.076***	0.269***	0.268***	0.234***	0.234***	-0.026	-0.024	-12.748	-12.368
	(0.013)	(0.013)	(0.025)	(0.025)	(0.021)	(0.021)	(0.023)	(0.023)	(0.061)	(0.061)	(8.966)	(8.973)
age of mother	-0.000	-0.000	0.001	0.001	-0.003***	-0.003***	-0.003***	-0.003***	0.000	0.000	0.032	0.026
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.004)	(0.004)	(0.302)	(0.302)
mother's age at first birth	0.003***	0.003***	0.001	0.001	0.002*	0.002*	0.003*	0.003*	-0.007	-0.007	-1.982***	-1.914***
	(0.001)	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.004)	(0.004)	(0.457)	(0.456)
years of schooling mother	-0.003***	-0.002***	0.007***	0.007***	0.007***	0.006***	0.008***	0.008***	-0.001	-0.001	-0.975*	-0.775
	(0.001)	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)	(0.002)	(0.002)	(0.004)	(0.004)	(0.583)	(0.583)
polygamous household	-0.000	-0.001	-0.005	-0.005	-0.002	-0.002	-0.026***	-0.026***	0.009	0.005	23.621***	23.583***
	(0.006)	(0.006)	(0.010)	(0.010)	(0.008)	(0.008)	(0.010)	(0.010)	(0.027)	(0.027)	(3.846)	(3.847)
gender of child (girl=1)	0.002	0.002	0.009	0.009			0.011	0.011*	-0.020	-0.020		
	(0.005)	(0.005)	(0.008)	(0.008)			(0.007)	(0.007)	(0.023)	(0.023)		
age of child (in months)	0.001***	0.001***	0.003***	0.003***			-0.002***	-0.002***	0.003***	0.003***		
	(0.000)	(0.000)	(0.000)	(0.000)			(0.000)	(0.000)	(0.001)	(0.001)		
nr. of children < 5 in HH	0.000	-0.002	-0.003	-0.003	0.023***	0.023***	-0.006	-0.006	0.009	0.009	-36.945***	-36.995***
	(0.003)	(0.004)	(0.005)	(0.005)	(0.004)	(0.004)	(0.005)	(0.005)	(0.018)	(0.018)	(2.389)	(2.389)
ethnicity of mother	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
birth order	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	No	No
DHS survey year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
cluster fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	14,472	14,472	14,472	14,472	11,958	11,958	16,312	16,312	1,976	1,976	11,958	11,958
R2	0.27	0.26	0.24	0.24	0.37	0.37	0.32	0.32	0.49	0.49	0.18	0.18
Adjusted R2	0.19	0.18	0.16	0.16	0.28	0.28	0.26	0.26	0.27	0.27	0.07	0.07

*Notes: *** p<0.01, ** p<0.05, * p<0.1; Robust standard errors are clustered at the household-level and reported in parentheses; Information on the relationship between witchcraft and AIDS was only asked in the 2006 and 2012 DHS survey rounds; We compare estimates that (do not) control for mother's reported belief that AIDS can be caused by witchcraft; To allow for a meaningful comparison, we restrict the sample to the observations for which information on this belief is available; All specifications are estimated using a Linear Probability Model.*

Table A.13: Healthcare services chosen by ATR mothers

	visit health facility	traditional birth attendant	traditional healer to treat diarrhea or fever	use of ORS to treat diarrhea	use of medication to treat fever
	(1)	(2)	(3)	(4)	(5)
mother is an ATR adherent	-0.047***	0.020***	0.017***	0.000	-0.081***
	(0.010)	(0.005)	(0.006)	(0.031)	(0.021)
visited a traditional healer				-0.082**	-0.176***
				(0.040)	(0.046)
Wealth quintile:					
2	0.035***	-0.008	-0.006	-0.017	0.007
	(0.011)	(0.005)	(0.007)	(0.033)	(0.022)
3	0.066***	-0.009*	0.001	0.072**	0.008
	(0.011)	(0.005)	(0.007)	(0.037)	(0.023)
4	0.079***	-0.021***	-0.014*	0.067	0.086***
	(0.013)	(0.005)	(0.008)	(0.044)	(0.025)
5	0.117***	-0.019***	-0.014	0.171**	0.123***
	(0.018)	(0.005)	(0.010)	(0.070)	(0.038)
age of mother	-0.004***	0.001*	0.001**	-0.001	0.002
	(0.001)	(0.000)	(0.001)	(0.003)	(0.002)
mother's age at first birth	0.000	0.000	-0.002**	0.009**	-0.006**
	(0.001)	(0.001)	(0.001)	(0.004)	(0.003)
years of schooling mother	0.009***	-0.001***	-0.000	0.006	0.007**
	(0.001)	(0.000)	(0.001)	(0.006)	(0.003)
polygamous household	-0.030***	0.005*	0.002	-0.025	-0.023
	(0.007)	(0.003)	(0.004)	(0.023)	(0.015)
nr. of children < 5 in HH	0.023***	0.002	-0.003	0.030***	0.007
	(0.004)	(0.002)	(0.003)	(0.010)	(0.008)
age of child (in months)	-0.002***	0.000**	-0.000	-0.001	0.000
	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)
gender of child (girl=1)	-0.002	0.001	-0.002	-0.024	-0.005
	(0.005)	(0.002)	(0.004)	(0.020)	(0.012)
ethnicity of mother	Yes	Yes	Yes	Yes	Yes
birth order	Yes	Yes	Yes	Yes	Yes
DHS survey year	Yes	Yes	Yes	Yes	Yes
cluster fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	35,106	34,984	10,318	3,262	6,430
R2	0.29	0.28	0.26	0.53	0.42
Adjusted R2	0.24	0.23	0.10	0.24	0.26

*Notes: *** p<0.01, ** p<0.05, * p<0.1; The dependent variables are dummy variables which take the value one if, respectively: (1) a mother visited a health facility in the 12 months prior to the interview; (2) a traditional birth attendant assisted with the delivery of the child; (3) a mother visited a traditional healer to treat the diarrhea or fever of her child in the two weeks prior to the interview; (4) a mother used ORS to treat her child's diarrhea; (5) a mother used conventional medication (which includes aspirin, ibuprofen, paracetamol and several anti-malarial medications) to treat her child's fever. In columns 3-5 the sample is restricted to mothers whose child had diarrhea or fever in the two weeks prior the interview; Robust standard errors are clustered at the household-level and reported in parentheses.*

Table A.14: Potential hurdles to visiting a health center

		No problem	Small problem	Big problem	Obs.
		(1)	(2)	(3)	
(1)	Knowing where to go	0.021	-0.007	-0.014	3,305
		(0.020)	(0.007)	(0.013)	
(2)	Maybe no female health worker	0.030	-0.008	-0.022	3,305
		(0.019)	(0.005)	(0.014)	
(3)	Having to take transport	0.044**	-0.015**	-0.030**	3,301
		(0.021)	(0.007)	(0.014)	
(4)	Getting permission	0.054***	0.006**	-0.060***	11,594
		(0.016)	(0.003)	(0.018)	
(5)	Money for treatment	0.028***	0.030***	-0.058***	11,591
		(0.009)	(0.009)	(0.018)	
(6)	Distance	0.038***	0.022***	-0.060***	11,586
		(0.012)	(0.007)	(0.018)	
(7)	Not wanting to go alone	0.082***	-0.005	-0.078***	11,593
		(0.016)	(0.004)	(0.014)	

*Notes: *** p<0.01, ** p<0.05, * p<0.1; We estimate seven specifications, looking at the determinants of each potential hurdle to visiting a health center; For each hurdle, mothers indicate whether it presents 'no problem', 'a small problem' or 'a big problem'; The reported coefficients represent marginal effects of mothers' ATR adherence for each answer category, calculated after an Ordered Probit regression; Robust standard errors are clustered at the level of the survey cluster and reported in parentheses; In every specification we control for the set of baseline covariates (all those reported in Table 7 of the paper) and we include cluster-level fixed effects; Information on the first three hurdles was only available in the 2001 survey, information on the other hurdles was available in the 2001 and 2012 surveys.*